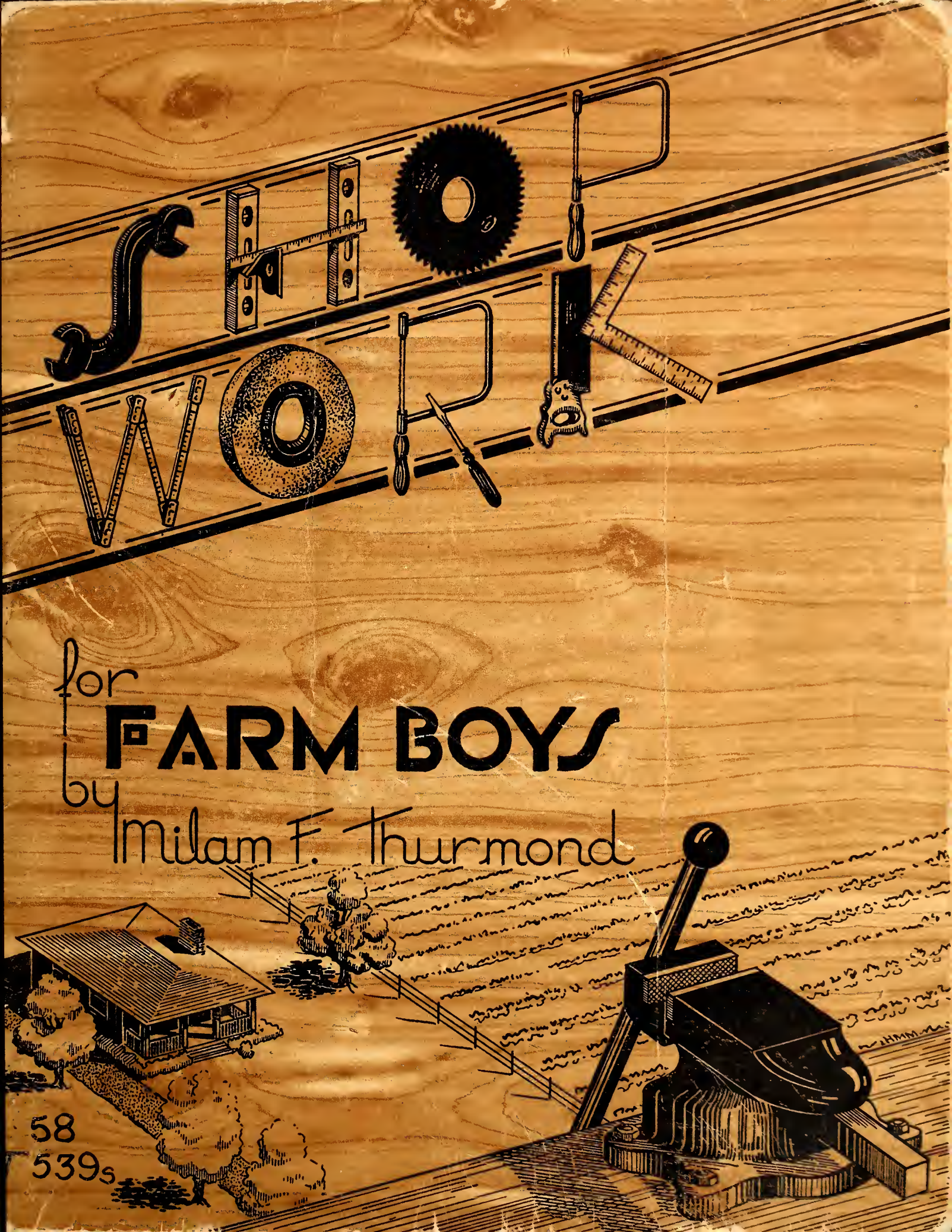
WOODWORK

for

FARM BOYS

by Milam F. Thurmond



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SHOP WORK

FOR

FARM BOYS

SHOP TOOLS HARDWARE ROPE HARNESS

SHEET METAL & SOLDERING BLACKSMITHING PLUMBING CONCRETE

FIGURING BILLS OF MATERIALS FARM WOODWORK ROOF FRAMING

PAINTING ELECTRICITY FARM FENCING THE FARM LEVEL

COURSE OF STUDY USEFUL TABLES

MILAM F. THURMOND
Associate Professor Agricultural Engineering
Agricultural and Mechanical College of Texas
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FIRST EDITION
1940

Withdrawn from UT

INTERSTATE PRINTING CO.
Printers & Publishers
DANVILLE, ILLINOIS

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ACKNOWLEDGMENTS

The author wishes to acknowledge much valuable help received from Texas Vocational Agriculture Teachers; the Department of Agricultural Education, A. & M. College of Texas; and Mr. Robert A. Manire, Director, Vocational Agriculture, Department of Education, Austin, Texas.

My thanks go to the following manufacturers for the use of cuts and illustrative material:

The Bostrom-Brady Level Company
Sargent and Company
The Delta Manufacturing Company
Stanley Rule & Level Co.
Goulds Pumps, Inc.
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Irwin Auger Bit Co.
Extension Service, A. & M. College, of Texas.

12-15-48 - Interstate Printers & Pubs. - Agriculture

INTRODUCTION

There are thousands of boys throughout the country studying agriculture. They are constantly reminded that they must keep up with the times if they are to be successful. They face the farm shop problems daily. They need to be taught how to do these jobs and do them correctly. Farm boys are naturally inclined to be mechanical. This, no doubt, has come about by the early training of parents who have taught boys how to work with their hands.

The pioneer farmer found it necessary to equip and maintain a home shop to enable him to carry on and make a crop. The home shop is even more important today. Cost of production is being cut through new and improved machinery. This machinery must constantly be repaired. Much of this repair must be done by the farmer himself. In busy seasons when time is a valuable item, one cannot afford to take parts to town for repairs. The farm shop is even more important during slack or dull seasons as it affords a place to do many jobs that have been laid aside for the occasion.

Vocational Agriculture students carrying projects along with their course need to do farm shop jobs that are related to their projects. For example, a boy who has poultry as a project may need to construct a poultry feeder, build a brooder, or a poultry house. Training in farm shop work will be a great help to him.

We must not overlook the fact that our farm boys need specific training in Farm Shop work. They need to know more about the engineering phase of farm work.

Hundreds of Vocational Agriculture schools throughout the country have provided Farm Shops to give the boys the necessary training. These shops are equipped to do the many mechanical jobs that occur on the farm. Where a school has a good farm shop the students are using it to a good advantage. Where they do not have a home shop, they can bring many of their jobs to school and repair them there.

This book has been prepared to help the students taking Vocational Agriculture in the secondary schools. It will serve as a guide for the teacher. The skills set forth in this book are based primarily on the jobs done on the average farm. Jobs related to home projects should not be overlooked and the students should be encouraged to bring jobs from their homes.

In preparing this book the author has prepared many questions to bring out the importance of jobs that need to be done by the boy on his own farm.

Teachers will find that through a good course in farm shop they will be enabled to interest the boy in better farming. It will add interest to the class work and will receive the attention of the parents who will in turn offer better cooperation between the teacher, the boy, and the home.

TABLE OF CONTENTS

SHOP TOOLS PAGE

1. Identification of tools 7
2. Inventory of tools 9
3. Care and use of tools 10
4. Hardware identification 17

ROPE AND HARNESS

1. Rope Machine 18
2. How to make rope 19
3. Questions on rope 21
4. Harness sewing thread 22
5. How to make a leather splice 23
6. How to make a leather halter 24
7. Questions on harness, and leather work 25

HEET METAL AND SOLDERING

1. Soldering 26
2. Questions on soldering 28
3. How to make a sheet metal pan 30
4. How to generate a blow torch 30
5. How to make a dust pan 31
6. How to make a funnel 32
7. How to make a tool carrier 33

BLACKSMITHING

1. How to make a cold chisel 34
2. How to make nail sets and punches 34
3. How to make a hay hook 35
4. How to make a clevis 35
5. How to make a fire shovel 36
6. Questions on blacksmithing 36

MACHINERY REPAIR

1. Checking worn parts on machines to be repaired 37

FARM PLUMBING PAGE

1. Identification of pipe fittings 39
2. Threading pipe 40
3. Fitting pipe 40
4. Water systems 41
5. A study of home water systems 42

CONCRETE WORK

1. Estimating quantities of materials 44
2. How to make side walks 46
3. How to make concrete steps 47
4. How to make flag stones 48
5. How to make a movable shoe scraper 48
6. Methods of curing concrete 49
7. Testing sand 50

FIGURING BILLS OF MATERIAL

1. Methods of figuring bills of material 51
2. Questions on lumber 53
3. Figuring materials for a tool cabinet 54
4. Figuring materials for a work bench 55
5. Figuring materials for a nail box 56
6. How to make a tool carrier 57
7. How to make a harness stitching clamp 57
8. How to make a saw horse 58
9. How to make a budding knife 59
10. How to make a book rack 59
11. Plans for eveners 60
12. Hog lot equipment 61
13. Trellis designs 62

FARM TRAILERS

1. Plans for a farm trailer 63

ROOF FRAMING

1. Roof types 66
2. Roof Framing 67

TABLE OF CONTENTS

(CONTINUED)

PAINTING PAGE

1. The use, composition and application of paints stains, and varnishes 76
2. Care of paint brushes 79
3. Window glazing 80
4. Questions and problems on farm painting 81

ELECTRICITY

1. How to read a meter 82
2. How to make a joint or splice 83
3. Illustrations showing correct methods of wiring 84
4. Questions on electricity 85

FARM FENCING

1. Life of Fence Post 86
2. Field Layouts 87
3. Fence problems 88

TERRACING

1. How to test and adjust the Bostrom level .. 89
2. Questions on terracing 90

PAGE

3. Illustration showing how to run different kinds of terrace lines 92
4. Terracing signals 93

COURSE OF STUDY

1. An outline of a Farm Engineering course of study for high schools 94
2. List of shop equipment for a class of 20 students 98

REFERENCES ON FARM SHOP 101

USEFUL TABLES

1. Weights, measures, estimates 105
2. Cost of operating electric equipment on the farm 106

PROJECT REPORTS

1. Summarized list of jobs done in the shop and at home 113

JOB SPECIFICATION

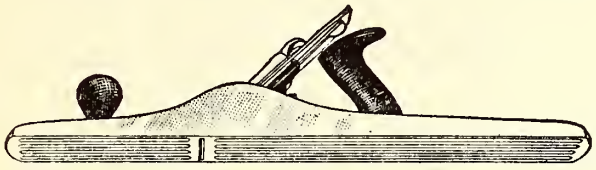
To become familiar with the names of tools used in the shop, with some idea of price and use.

References:

Stanley tool catalog No. 34-A.
General hardware catalogs.

Procedure:

Give the correct name of each tool below, one use for which tool is used and an average price.



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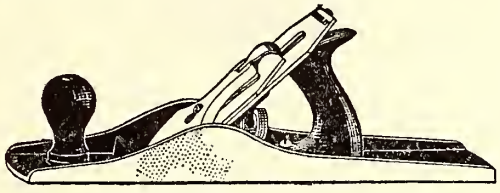

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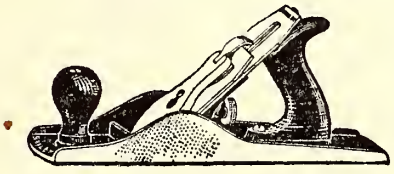

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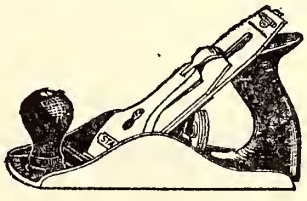

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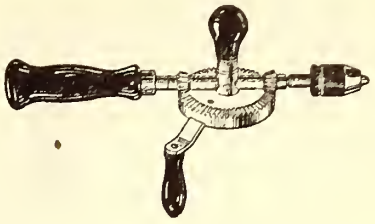

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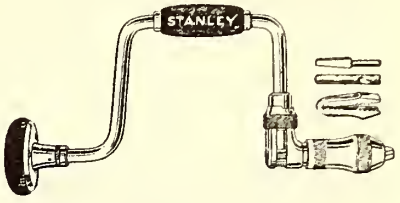

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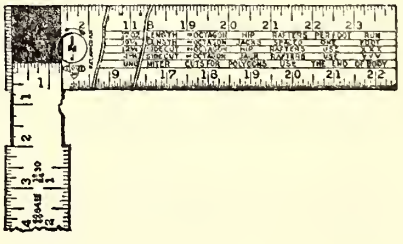

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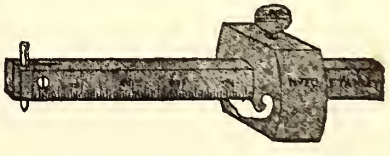

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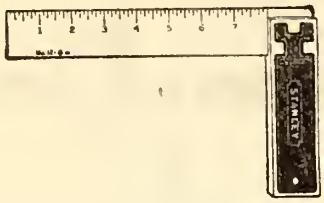

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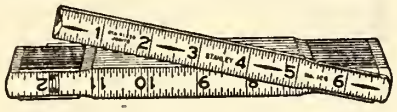

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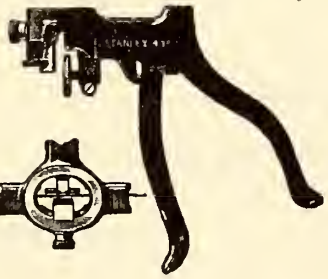

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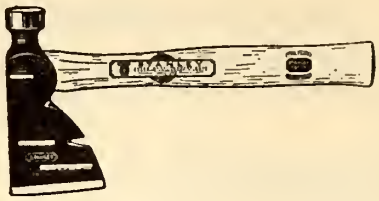

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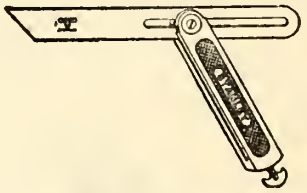

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JOB SPECIFICATION

To take an inventory of the tools used in the shop and note their condition.

Procedure:

List all the tools in the cabinets No..... .... Note the condition of each tool and give the price range for each.

Tools that are missing should be listed below, as well as the others and marked "missing".

Name	Price Range	Condition of Tool

THE CARE AND USE OF TOOLS

A tool is no better than the care it receives. The shop man who allows his tools to rust, is careless about keeping them in order when not in use, and fails to keep them sharp and in good condition, will usually be found a careless workman. It is an indication that the work he turns out will be crude and there will be a lack of an appreciation of good workmanship.

Moisture against a steel face, unless that face is well protected, means almost immediate rust. In order to keep a saw blade in the most perfect working condition, it must be entirely smooth on either side. Rust means pitting, and therefore, a rough surface. When you finish using a saw, rub it down with an oiled rag. Sperm oil is the best for this. In case the saw has been slightly rusted it is well to rub the blade down first with fine emery cloth and then apply the oil.

Another important thing is the way in which edge tools are put away. Whether a saw is placed in a tool box or on a shelf, or hung from a nail or hook, always take care that the tooth edge is placed in such a position that no other tools will knock against the teeth and injure them. Ordinary precaution will protect the teeth so that they will stand up a normal length of time.

The manner in which tools are placed on the bench when not in actual use is extremely important. These tools should always be placed with the cutting edges away from the person using them. An axe or hatchet should never be left standing on the floor where the foot may accidentally strike it. A saw should never be hung from a bench where the teeth can scratch a leg or knee.

When you are through using a tool lay it down carefully. Do not drop it. A file, for instance, is an edge tool. Its teeth, to give the greatest efficiency, are very hard. When a man carelessly throws a file across his bench, he is liable to break off the edges of several teeth. A good tool deserves good treatment and the more care you give it, the better service it will give you.

Common sense will lay down for you most of the necessary rules for caring for your tools. Keep them in good working order, in a clean container or neatly arranged on hooks, and keep them in a dry place. If these instructions are followed out, there should be no question of the tools losing their efficiency except as they wear out from old age.

SHARPENING A PLANE IRON OR A WOOD CHISEL

Sharp tools save time and make work a pleasure. It seems to take a great deal of time to keep the tools in good condition, but it always pays. Accidents occur less frequently from sharp tools than from dull ones. Learn to sharpen your tools quickly and do not hesitate to take time to do it. A good carpenter starts the day off with sharp tools. A good sharp edge is no better than the quality of the tool itself. Do not except to keep sharp tools if they are cheap tools made from inferior materials.

Procedure:

The first step in sharpening a plane iron is to grind the iron to the correct shape desired. Care should be taken to get the bevel uniform. Use a try square to aid in measuring the correct curve.

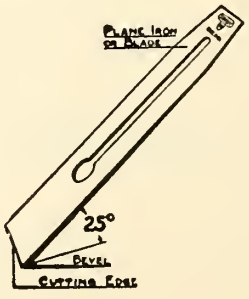
When to Grind a Plane Iron or Chisel

When the cutting edge is nicked.

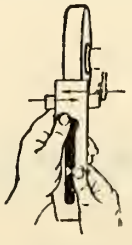
When the bevel has been worn down by much whetting.

When the bevel has been rounded by careless whetting.

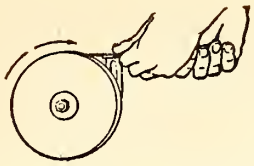
After the plane iron has been ground to the proper shape the bevel should be about 25° as shown in the drawing. It will be a little longer than twice the thickness of the plane iron.



In grinding, the plane iron should be moved from side to side to grind all parts of the bevel and keep the wheel true. The edge should be straight



and almost at right angles to the sides of the plane iron.



The grindstone should turn toward the Plane Iron.

Care should be taken not to burn the iron when grinding. It should be dipped in a bucket of water as needed to keep cool. Grinding should continue until the edge has become very thin. The heel line should be of the same uniform curve as the cutting edge of the iron.

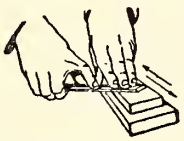
Whetting:

Place some thin oil on the stone then put the heel of the iron down. Raise the blade until the

Correct bevel position.

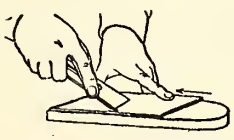
oil has moved out from under the blade making contact with the stone. The plane iron is then in the correct position for whetting. Care should be taken not to rock the plane iron when whetting.

Use as much of the surface of the stone, when whetting, as possible. Remove the wire edge which



Whetting on flat side.

has formed on the unbeveled side, by holding the plane iron with the unbeveled side absolutely flat on the stone. If it is found difficult to remove the wire edge strike the plane iron lightly across the rock, holding it at 90° to the rock. Then re-



Stropping on leather.

peat the operation. A fine rock should be used for finishing the whetting. A piece of leather tacked on a board may be used to a good advantage in finishing. Strike the plane iron a few strokes as one would in sharpening a razor.

Test for Sharpness:

Test the edge with the thumb or fingers. If the edge feels smooth and at the same time sticks or pulls, as you draw your thumb across it, it is sharp. Another way is to wet the thumb nail and draw the plane iron across it. If the edge is not sharp it can be easily detected.

Care of the Plane:

The plane should always be placed on the side when not in use. When it is stored away, if the plane iron is not run back into the plane, it should be placed in such a way that the cutting edge will not come in contact with anything. The plane should be kept oiled and free from rust.

References:

1. Farm Mechanics Text and Handbook, Cook, Scranton & McColly, Chap. V, Interstate, Danville, Ill., 1939.
2. Stanley charts.
3. Agricultural Mechanics, Smith.
4. Principles of Farm Mechanics, Sharp and Sharp.
5. Sharpening Hand Woodworking Tools, Coggin, Armstrong & Giles, Interstate.

* * * * *

SHARPENING A DRAW KNIFE

Fig. 1.

The draw knife may be ground on a small wheel grinder, but it is well to have some assistance in running it so that both hands may be used for holding the knife. It is usually sharpened as shown in Fig. 1, the stone being moved back and forth at an angle across the cutting edge with a gradual movement of the stone from one end of the knife to the other. A combination stone of rather generous proportions is suitable for this, the coarse side being used first if needed.

SHARPENING KNIVES, HATCHETS, BITS AND OTHER EDGE TOOLS

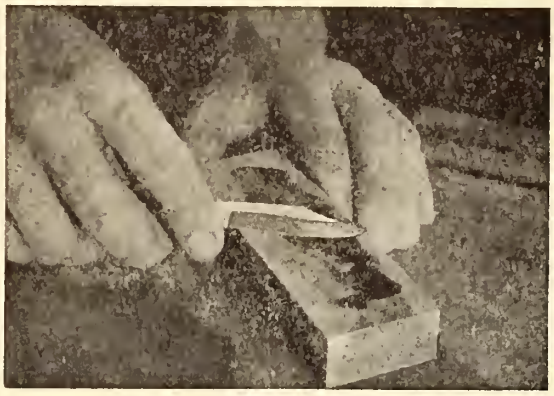


Fig. 2.

The pocket knife is the most important edge tool. It is used more than any other tool on the farm. (See Fig. 2.)

When sharpening a pocket knife, it should first receive a heavy whetting on the rough side of the stone or placed on a grind stone to eliminate nitches and any wire edge. Most people allow pocket knives to become too thick at the edge for good work. If this condition is remedied at each sharpening, there will be very little extra work to do at a time.

The pocket knife should be placed on the stone and receive the push stroke and not the pull stroke. Remember that the pocket knife cuts with a pull on the handle and the sharp edges on the blade should be in the opposite shape as the teeth on a rip saw.

The barber hones his razor with the same kind of a stroke as you would your pocket knife, but he reverses the edge on his razor upon stropping it. So the sharp teeth on a razor are in the same position as the teeth on a rip saw. Then for best results, the barber pushes his razor instead of pulling it.

* * * * * *

SHARPENING AN AXE

Fig. 3.

The reason that many axes do not cut better is that they are not properly ground before they are whetted and finished.

The chopping axe should be ground far enough back from the edge so that it will not act as a wedge when entering the wood. This is usually about one and one-half inches. After it has been ground, a smooth cutting edge should be put on it with a whet stone. (See Fig. 3.)

The champion wood cutter who cut a sixteen inch log in two in less than one minute, not only had his axe ground properly, but had the proper cutting edge.

* * * * * *

GRINDING A TWIST DRILL

It is difficult to get a twist drill properly ground so that each cutting edge will cut the same depth. The drill should be ground so that the bevel between the lips will be 59 degrees, while the bevel of the lips from the cutting edge will vary depending upon the kind of materials for boring. Usually this bevel is from 10 to 12 degrees. A properly ground drill will have a rounding surface from the cutting edge to the trailing side. (See Fig. 4.) This is preferable to flat surface because it makes

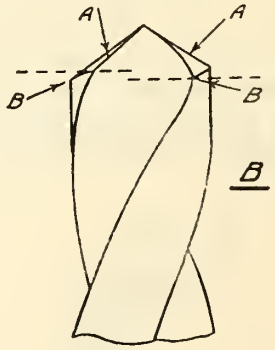


Fig. 4.

A.—Cutting Edges B.—Trailing Edges

a stronger backing for the cutting edge. If the drill is ground correctly, each lip will cut a spiral coil of metal as it is forced into the iron.

Cut a "V" notch in a small piece of tin at the proper angle for the two cutting edges. This is known as a templet. As the grinding proceeds, this templet may be fitted over the cutting lips from time to time to determine if the bevel is correct.

* * * * * *

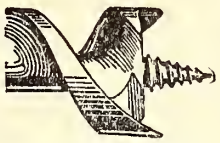
SHARPENING SHEARS OR SCISSORS

Grind or file the shears following the original bevel. They should then be whetted on a fine stone to remove the wire edge. The whetting is very similar to that of whetting a plane iron. Care should be taken not to bevel off the flat side.

SHARPENING AN AUGER BIT

Auger Bit

Auger bits become dull through constant use. Often the spurs or screws hit a nail and have to be refiled. Care should always be taken to prevent the bit from coming in contact with metal.



Auger Bit Head

Filing:

In regard to the filing of bits, in general they get more filing than is necessary. Some users even go so far as to file a new bit before they have used it. On account of the close relation of the parts of the boring head to each other and on account of their small size, it is not possible to file away much metal from the head of the bit without reducing its boring quality. Look at the bit carefully before you begin to file it.

To Resharpen a Spur:

Rest the bit on a board with the screw pointing up. Draw the file lightly on the inside of the spur. Never file a spur on the outside because that will destroy some of the clearance of the bit and very definitely impair its usefulness.

To Resharpen a Cutter:

Rest the bit on a board with the screw down. File the cutters on the upper edge only. If you take material from one cutter, take the same amount from the other one. It is essential that both cutters be on the same level so that they will cut chips of equal thickness.

Re-straightening the Twist:

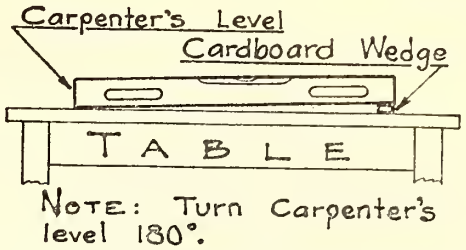
If through some abuse, such as heavy timber falling on a bit, it becomes sprung, it can often be straightened. Roll it on a level wood surface until the bend is located. Then tap it on the high side with light blows of a hammer.

Preventing Rust:

Moisture from the hand or sap from green timber may occasionally cause rust spots. If bits are wiped off now and then with an oily rag, this will be prevented.

* * * * * *

TESTING AND ADJUSTING A CARPENTER'S LEVEL



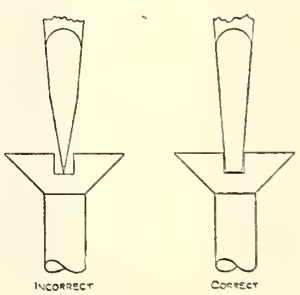
To test the level, place it on a flat surface. Place cardboard or other material under the lower end. Continue to raise the lower end until the bubble tube has come to rest in the center of the tube. Turn the level 180° on a horizontal plane. If the bubble remains the same, the level is in adjustment. (See Fig. above.)

To make proper adjustment, remove the plate and adjust screw by lowering or raising one end of the tube one-half the distance that the bubble tube moves upon reversing the ends.

Cheap levels made of wood that do not have an adjusting screw may be planed off to make the proper adjustment.

* * * * * *

SHARPENING A SCREW DRIVER



Many mechanics fail to sharpen their screw drivers correctly and as a result, a job may be defaced or an accident occur.

For best results the screw driver point should exactly fit the notch in the head of the screw. The bit should be ground so that it will fit snug in the opening of the screw.

SAW FITTING

References:

Text Book on Saws—Atkins.
Tool Manual—Henry Disston and Sons.
Principles of Farm Mechanics—Sharp and Sharp.
Saw Sense—E. C. Atkins.
Farm Mechanics Text & Handbook—Cook, Scranton & McColly, Chap. V, Interstate, Danville, Ill.
Sharpening Hand Woodworking Tools—Coggin, Armstrong & Giles, Interstate.

Procedure:

Secure a saw filing practice strip or a saw. Examine the teeth carefully to see if they are uniform in size and shape. If the teeth are uneven as shown in Figs. No. 8 and 9, they should be jointed. If the teeth are in good condition and fairly even, one or two strokes with a mill file will brighten up the points and aid in sharpening.

Fig. 1. Jointing the saw.

Lever Saw Set

The saw should first be jointed as shown in Fig. 1. If the teeth are in bad condition, they should be shaped and then set. Saws that have been kept in good condition should be set and then filed. "Setting" is springing over the upper part of each tooth; this causes them to cut a kerf somewhat wider than the blade and allows clearance for the blade. With the use of the saw set, spring every other tooth to the right. Reverse the saw and repeat the operation. Be sure the cutting edges are sprung out.

Fig. 2.—Looking down on the tooth-edge (magnified) of a cross-cut saw properly set.

Fig. 3.—Looking down on the tooth-edge (magnified) of a rip saw properly set.

Files:

The size of the file will be determined by the number of points per inch on the saw. The following sizes are recommended:

Cross Cut Saws

5 and 5½	pt. 7″ Slim Taper File
6 and 7	pt. 7″ Slim Taper File
8 and 9	pt. 6″ Slim Taper File
10 and 11	pt. 6″ Slim Taper File

Rip Saws

4 and 4¼	pt. 7″ Slim Taper File
5 and 5½	pt. 7″ Slim Taper File
6 and 6½	pt. 7″ Slim Taper File
6	pt. 6″ Slim Taper File

A 10 point saw has only 9 teeth per inch.

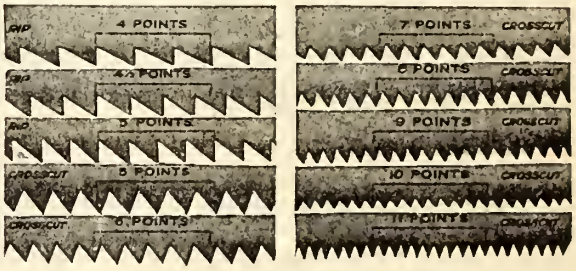


Fig. 4.

Place the saw filing practice strip in the saw clamp. The top of the teeth should extend from ¼″ to ½″ above the top of the clamp. The file should be held perpendicularly and horizontally to the saw.

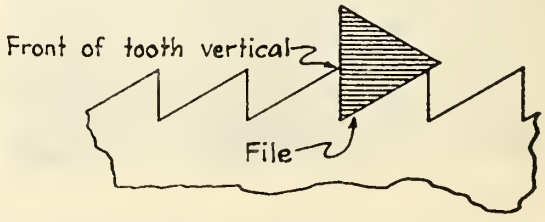


Fig. 5.—The teeth should be filed consecutively on a rip saw.

Cross-Cut Saws:

The operations for filing a cross-cut saw are about the same as for a rip saw, with the exception of the angle at which the file is held.

Place the file at an angle of 60° to the side of the saw. For ordinary work the angle of the front of the saw should be 12° from a vertical line. File every other tooth and reverse saw.

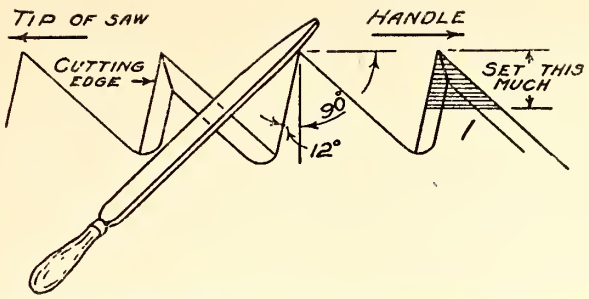


Fig. 6.—Enlarged teeth of cross-cut saw showing position of file and section of tooth to bend in setting.

The cutting sides of the teeth are pushed out when setting. Care should be taken to avoid uneven teeth and the wrong shape.

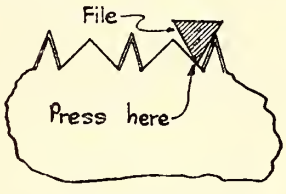


Fig. 7.

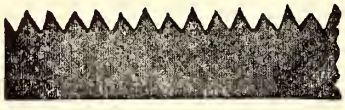


Fig. 8.—Uneven hand saw teeth.

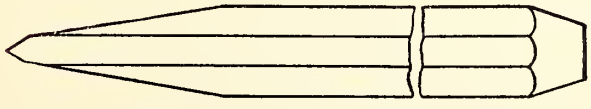
Fig. 9.—Uneven rip teeth.

How to Order a Hand Saw:

The following information should be given when ordering hand saws:

1. Specify rip or cross-cut saw.
2. Number of points to the inch.
3. Length of saw.
4. Manufacturer's number or style.

* * * * * *



Proper bevel for a cold chisel.

TO SHARPEN A COLD CHISEL

The cold chisel should be sharpened by grinding only. The angle at which it is ground will depend upon the job to be done. Usually the angle will be about 60 degrees.

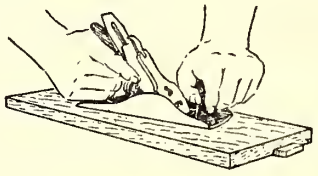
ILLUSTRATIONS ON CORRECT USES OF PLANES

It is easier to plane a long edge straight with a long plane than with a short one. A long plane bridges the low parts and does not cut them until the high spots are removed.

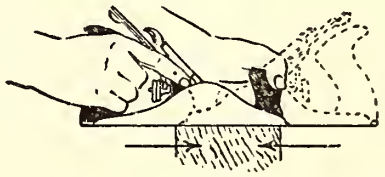
To start planing, take an easy but firm position directly back of the work.

Hold the plane square with the work face of the work.

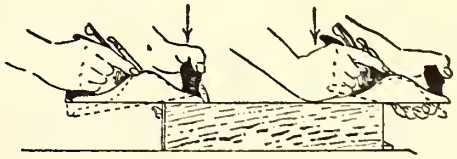
At the end of the stroke, the weight of the body should be carried easily on the left foot.



To keep the plane straight, press down on the knob at the beginning of the stroke and on the handle at the end of the stroke. Avoid dropping the plane as shown by the dotted lines.



Plane end grain half way from each edge. If the plane is pushed all the way, the corners will break.



To obtain a smooth surface plane with the grain. If the grain is cross or curly, set the plane iron cap as near the cutting edge as possible and adjust the plane iron to take a very thin, even shaving.

QUESTIONS ON TOOL SHARPENING

1. Make a list of the tools that you have at home that need sharpening.

2. What is the condition of the cutting edge of the majority of these tools?

3. Define "an edge tool".

4. How would you go about cleaning a rusty saw?

5. How may we keep tools from becoming rusty?

6. When would it pay to paint tool handles?

7. How are your shop tools stored at home?

8. How could you improve your storing methods at home?

9. Will it pay a farmer to keep his tools in good condition?

10. How may we be sure that we are buying good tools?

11. Compare sharpening a hoe to a plane iron.

12. When will it pay a farmer to sharpen his own plows?

13. What sharpening equipment do you have at home?

14. Give the principal causes of dulling hand saws.

15. How may you test the edge for sharpness of a plane iron?

16. What is the purpose of placing oil on a wet stone?

17. Why use water on a grindstone?

HARDWARE IDENTIFICATION

Job Specification:

To study different types of hardware used in the shop.

References:

Sharpening Hand Woodworking Tools—Coggin, Armstrong & Giles, Interstate.

Manual of Carpentry and Catalog—American Steel and Wire Co.

Farm Mechanics Text & Handbook, Cook, Scranton & McColly, Chap. III.

Agricultural Mechanics—Smith.

Materials and Equipment:

Materials listed below.

Procedure:

Secure the hardware listed below, sketch items and give one use for each:

Common Nail

Use .....

Casing Nail

Use .....

Finishing Nail

Use .....

Carriage Bolt

Use .....

Machine Bolt

Use .....

Stove Bolt

Use .....

Butt Hinge

Use .....

Strap Hinge

Use .....

T. Hinge

Use .....

Flat Head Screw

Use .....

Oval Head Screw

Use .....

Round Head Screw

Use .....

Coping Saw

Use .....

Hasp

Use .....

Hook and Eye

Use .....

Draw Pull

Use .....

Door Button

Use .....

Fence Staple

Use .....

ROPE

Rope Fibers

The fiber for the manufacture of rope is produced from a plant called Abaca, a variety of the banana plant growing in the Philippine Islands which produces the so called manila fiber, considered the best fiber used in the rope industry.

Although there have been many attempts made to grow the Abaca in other countries, most of them have been unsuccessful, and we still find the Philippines the foremost producers of the best fiber. The young plants grow best in cleared forest lands and need a certain amount of shade to protect them from the hot sun in the early stages of their growth. The plants are set out so that from five to six hundred may occupy an acre, at a distance of eight to ten feet between plants. Plenty of moisture is necessary, and during the three or four years of growth, the plant attains a height of eight feet and upward. After a lapse of three or four years a flower develops and it is then that the plant is cut to obtain the best type of fiber.

How the Fiber Is Cured

The natives cut down the whole plant, split the stalk open and remove the outer layers. In order to prevent the fiber from becoming hard and brittle under the blazing tropical sun, the layers are placed in the shade to dry slowly. By this method of curing, the pliability and tensil strength is obtained. After drying, the layers are scraped by natives until only the true fiber remains.

It is obvious that the greater amount of work and care, the cleaner the fiber will be, but few natives will work well enough to produce a large percentage of high grade fiber. Consequently, there are many grades and qualities of fiber, in fact there are said to be 33 distinct grades of Manila fiber all varying in length, strength, color and value. It is necessary, therefore, for the Philippine government to maintain an inspection bureau which carefully grades the fiber before it is placed on the market.

Other Important Sources of Fiber

Of almost equal importance to Manila fiber in the production of cordage is the fiber obtained from the Sisal plant. Fibers known in the industry as Sisal are grown extensively in certain provinces of Mexico, Africa, Bahama Islands and elsewhere. But the fiber universally known to the trade as Sisal is very largely produced in Yucatan, Mexico. Sisal is grown successfully on waste and arid lands and requires very little attention after setting. The plant is cactus-like, the fiber being coarse and not having the smoothness, pliability or strength of Manila. Although it is used largely for binder twine, a great deal of it goes into rope and a very good grade of rope is obtained, but it is not nearly as good as that made from Manila.

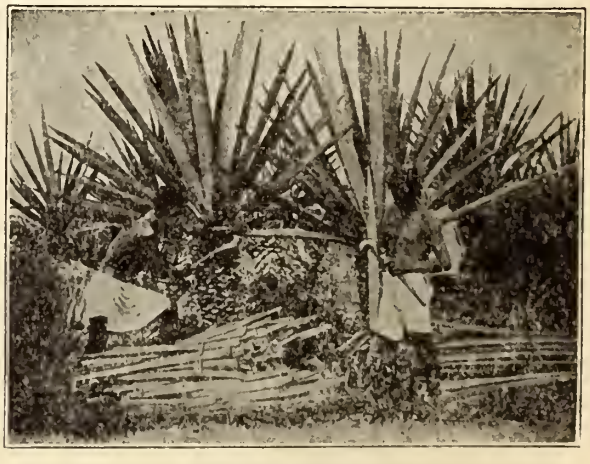
Maguey, another Philippine fiber, New Zealand and Mauritius fibers, the last two coming from islands of New Zealand and Mauritius, all are inferior fibers to Manila. Owing, however, to their good light color and the softness and pliability of the goods made from them, their fiber is often used as adulterant for Manila.

No Comparable American Plant

Manila, Sisal and other fibers we have mentioned, belong to what is known as the "hard fiber" group. The other class of fiber is called the "soft fiber" group, distinguished from hard fiber because the stems of the plants are softened to loosen the waste material before scraping. This softening process is done by submerging the stems of the plants in water or by leaving them lay on the field after cutting to absorb moisture. Jute, hemp and flax are the plants which produce this class of fiber. American hemp, grown chiefly in Kentucky and Wisconsin, constitutes a large source of the soft fiber supply. Soft fiber is not used extensively in the production of rope, but furnishes the material from which twines are manufactured.

It is unfortunate that as yet no plant has been found in America which will supply the raw material for the cordage industry. If a plant could be grown successfully to supply the demand for the necessary hard fibers, the large importation of tropical fibers would be unnecessary, and the American farmer would have another industry dependent upon his production.

The Manila Plant



The Sisal Plant

MAKING ROPE

Job Specifications

To make a rope machine and make rope.

Reasons for the Job

Rope can be made at home for about one-half the cost of retail price at the store. It only takes a few minutes to make a piece of rope, and it may be made any size and length needed. Good lariat rope may be made after one has had a little experience.

References

Plymouth Cordage Company, North Plymouth, Mass. for information on rope and its uses.

Knots and Splices—Extension Bul. No. 33—University Farm, St. Paul, Minn.

Rope and Its Use—Extension Bul. No. 24—Iowa State College, Ames, Iowa.

Hitches, Knots and Splices—Extension Bul. No. 62—Cornell University, Ithaca, N. Y.

Practical Uses of Rope on the Farm—Circular No. 301—Experiment Station, Urbana, Illinois.

Farm Mechanics Text & Handbook—Cook, Scranton & McColly, Chap. XIII, XV.

The Bill of Material

1 piece 1″ x 8″ x 48″
3 pieces No. 6 wire, 9″
1 piece 1″ x 3″ x 18″
1 –¼″ x 6″ carriage bolt.

Procedure

1. Cut out lumber according to plans.

2. Place the small triangular board on the large one and bore holes through both pieces at the same time. This is done to make sure that the holes line up. The holes should be the same size as the wire to be used. In case a bit is not available in the correct size, one may be made out of a nail or short piece of the wire that is being used.

3. Make the washers by driving a hole through a piece of sheet metal with a nail. If solder is not available, washers may be bradded on or the ends of the wire turned down to keep the board on. The front washers may be eliminated, but will be better if soldered on. If possible, bend all three wires in a vise at the same time so they will be exactly alike.

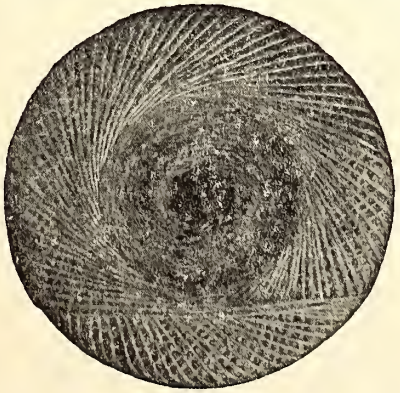


Fig. 1. Binder Twine.

How to Make Rope

1. Secure a ball of binder twine, sisal, or Manila. (Manila is more expensive, but much better —always use it for lariats.)

2. Place rope machine in bench vise, nail on something solid, or have two boys hold the machine. Have a boy place the end twister as shown in Fig. 3 around his body with the rope about even with his hips.

4. Begin at the end twister and tie on twine. Place the desired number of threads on this hook and on one of the hooks of the machine. Continue until you have placed the same number of threads on each of the three hooks. (Note: If you are making a 15 thread rope, all 15 threads will be on the end hook, while there will be 5 threads on each of the hooks on the machine.) Allow about 15% more in length than you expect the finished rope to be. This takes care of the shrinkage.

5. Turn the machine to the right until the three strands are very tight.

6. Place forked limb stock at end of the rope between strands.

7. Turn end handle to **left** and rope machine to the **right** at the same speed. Hold forked limb stock firm and press toward the end twister. As the end twister is turned, it will move the forked limb stock toward the rope machine forming the rope.

8. After rope is completed, singe over a flame.

Fig. 2. Forming the Rope

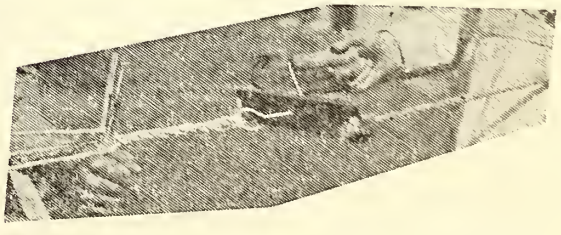
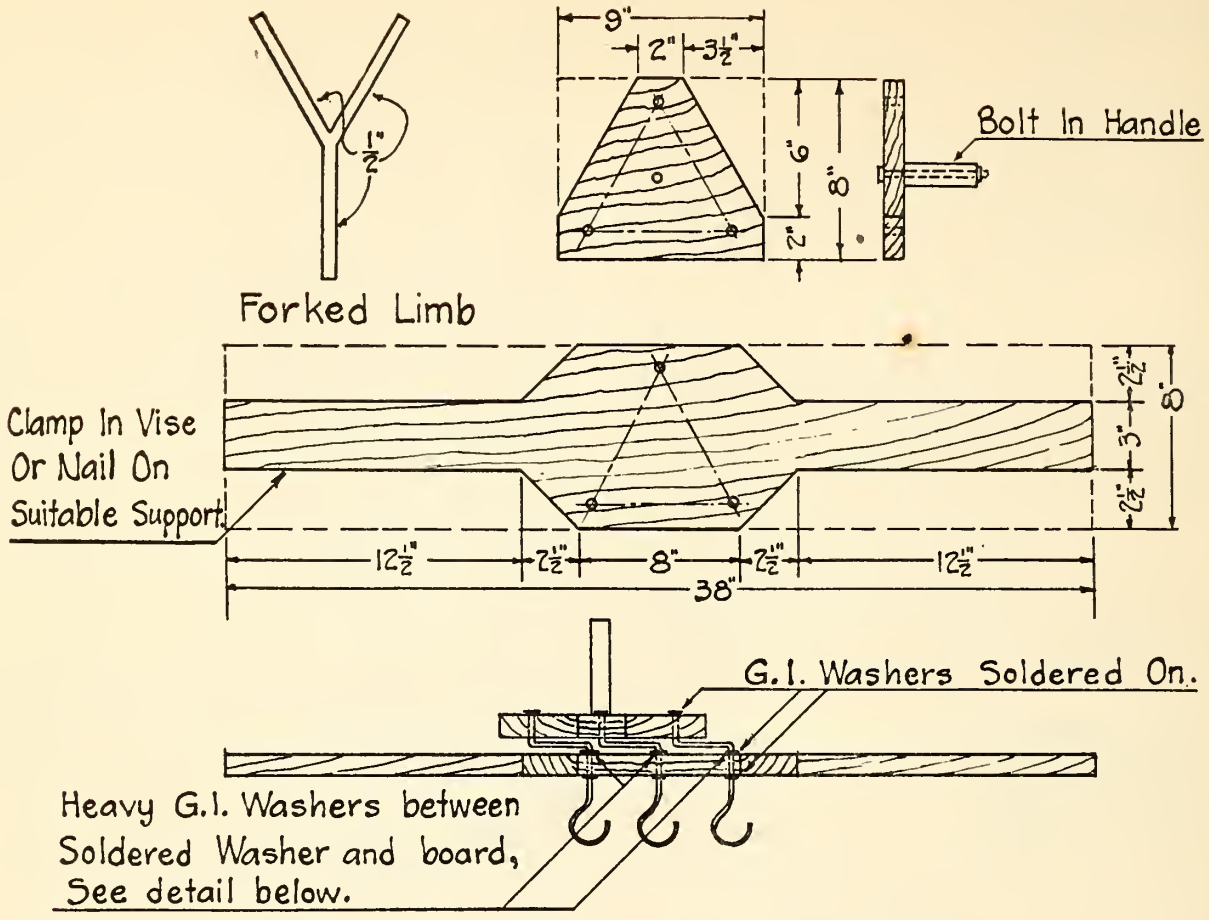
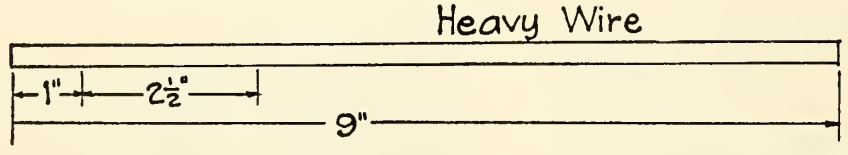
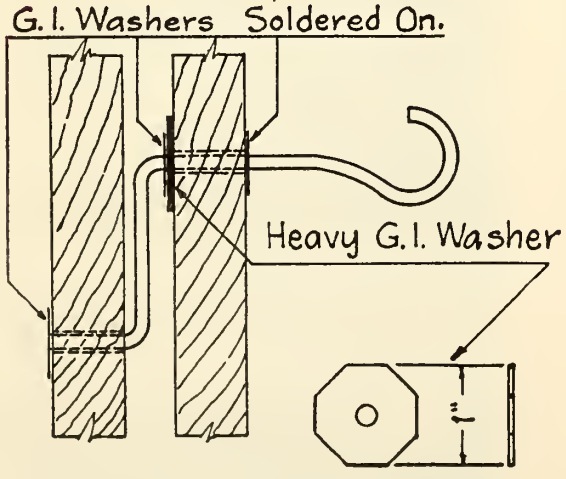
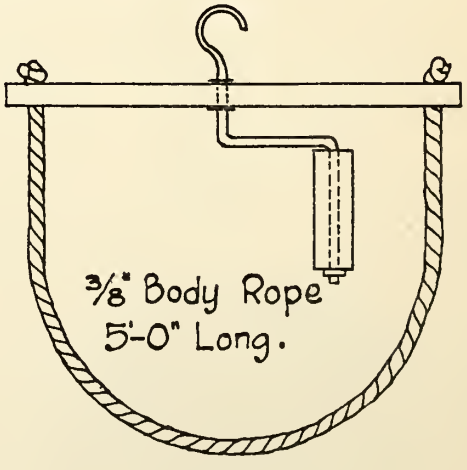


Fig. 3. Showing Direction of End Twister.









PLANS FOR MAKING ROPE MACHINE

Fancy Colored Rope

Fancy colored rope may be made by winding a small amount of twine on a stick and dipping in thin paint and allowing to dry before using. Colors may also be obtained by dipping twine in Putman or Diamond dyes. The directions for coloring should be followed as given on the package.

One or two colored strings put in the rope when making will make it more attractive.

Sizes and Lengths of Rope

The size of the rope will depend upon the number of threads of twine and the size of the threads.

9 threads make—$\frac{1}{4}$" rope
18 threads make—$\frac{3}{8}$" rope
24 threads make—$\frac{1}{2}$" rope

Make a Lariat and Record Data Below:

No. Strands Used	Kind Fiber	Length at Start	Length of Finished Rope	Diam. of Rope	Wt.	Cost

Time required.....

Knots That Every Boy Should Know How so Tie:

1. Square knot
2. Clove hitch
3. Timber hitch
4. Rope halter
5. Halter tie
6. Granny or False knot
7. Eye on end of rope
8. Whipping end of rope
9. Crowning end of rope
10. Sheep shank
11. Double bow
12. Half hitch
13. Short splice
14. Weaver's knot

QUESTIONS ON ROPE

1. What is the principal difference between Manila rope and sisal rope?

.....

.....

.....

2. Secure prices on rope at the store.

Kind	Size	Cost lb.	Cost per ft.

3. List the general uses of rope on the farm.

.....

.....

4. What is the effect of weather on rope?

.....

.....

5. What factors should be considered in the selection of rope?.....

.....

6. When would it pay a farmer to make his own rope?

.....

.....

7. How may one profit by being able to tie the useful knots and make the necessary splices needed on the farm?

.....

.....

.....

8. What are some essentials of a good knot or hitch?.....

.....

9. What are the requirements of a good lariat?

.....

.....

10. Compare the cost of a home-made lariat to a bought one.....

.....

11. List a few of the knots that you should know how to tie for farm use.....

.....

.....

.....

12. What kind of knot do you use in tying your shoe strings, a square knot or a "granny" knot?

.....

Explain the difference.....

.....

.....

13. What kind of knots may be used to be placed in the end of a lariat?.....

.....

14. What kind and size of rope is best for rope halters?.....

.....

.....

HARNESS SEWING THREAD

Job Specification

To make waxed thread for repairing harness.

Materials and Equipment

Harness wax, No. 10 linen thread, harness needles.

References

Farm Engineering—Robb and Behrends.

Harness Repair—Cornell Univ. Bul. No. 160.

Farm Mechanics Text & Handbook—Cook, Scranton & McColly, Chap. XVIII.

Procedure

Draw out from the center of the ball of thread (No. 10 linen) a piece about three feet long. The length will be determined by the job to be done.

Hold the thread between the thumb and the finger of the left hand. Move the right hand down the thread about eight inches and with the forefinger and thumb untwist the thread and pull apart. This operation is what is known as tearing. Repeat this process until you have three threads.

Assemble the threads by placing the ends about an inch or more apart. This will give a long tapering end so that it may be placed in the eye of the needle easily.

Place the assembled ends over a nail, drawing the ends toward you. Wax the ends by placing them on a waxed pad. The threads should be twisted and waxed from end to end.

Draw one tapered end of the thread through the eye of the needle for a distance of two or three inches, bend back and roll it down. Place a needle on the other end.

The Threads Ready to Wax

LEATHER SPLICE

Job Specification

To make a leather splice by stitching.

Materials and Equipment

Leather, knife, sewing thread, stitching clamp, awl, needles, harness wax, and pricking wheel.

Procedure

Using a No. 10 linen thread, measure off about 24 inches, tear, assemble and wax three threads.

Trim off the flesh sides of the 2 pieces of leather back about two inches from the end. Place the 2 pieces of leather together with the flesh side to the hair side and place them in the clamp.

Make the holes with the awl, and when you have come to the end, cross over as shown in the drawing. Continue stitching and as the last stitch is made, place one needle through the hole and loop over the other needle twice, as shown in the drawing and draw both ends up tight, tieing with thread.

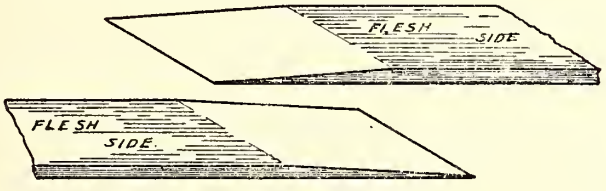
SEWING COMPARED TO RIVETING

The question which often arises is whether a sewed splice is superior to a riveted splice and worth the extra time and trouble involved in its making; and should rivets be used determine the best kind and number to use. The following table will aid in this problem:

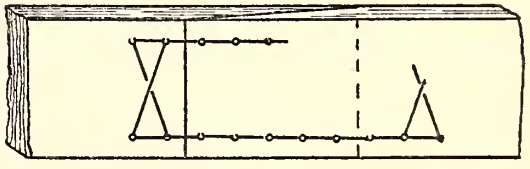
Strength Tests of One Inch Standard Leather Team Lines

Splice	Av. lbs.	% of normal strength of unspliced strap
Unspliced	845	100
Hand sewed	665	79
Machine sewed	635	75
3 copper rivets and burrs	470	56
2 copper rivets and burrs	325	38
3 tubular rivets	370	44
2 tubular rivets	270	32
3 split rivets	280	33
2 split rivets	190	22

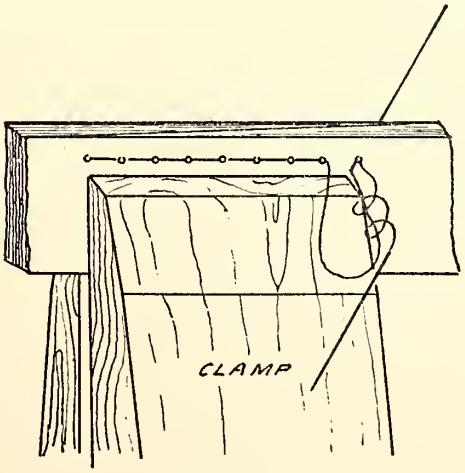
Ten tests were made of each splice in which a 3½ inch lap was used. Tests made at Division of Agriculture Engineering, Univ. of Minn. 1928. Riehle testing machine used.



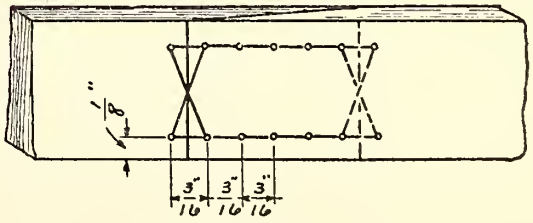
CORRECT JOINTING



WRONG WAY



TIEING.



RIGHT WAY

CROSSING OVER

LEATHER HALTER

Job Specification

To make a leather halter.

Materials and Equipment

Leather gauging knife, rivets, rivet machine, punch.
4 – 1½" rings
2 – 1¼" x 1½" halter squares
1 – 1¼" bar roller buckle.

Procedure

1. Cut nose strap 1¼" x 15½". Turn back 1¼" at each end and rivet or sew each end in narrow side of a halter square.

2. Cut chin strap 1¼" x 18". Turn back 1¼" on one end and rivet or sew to opposite side of one halter square. Fit the two rings in so that one will slip in the doubled strap and is held in place by the second ring which slips in the single strap. Turn back 1¼" of end and rivet or sew to other halter square. A more durable and stronger halter may be made by using a short piece of tire chain instead of leather for the chin strap.

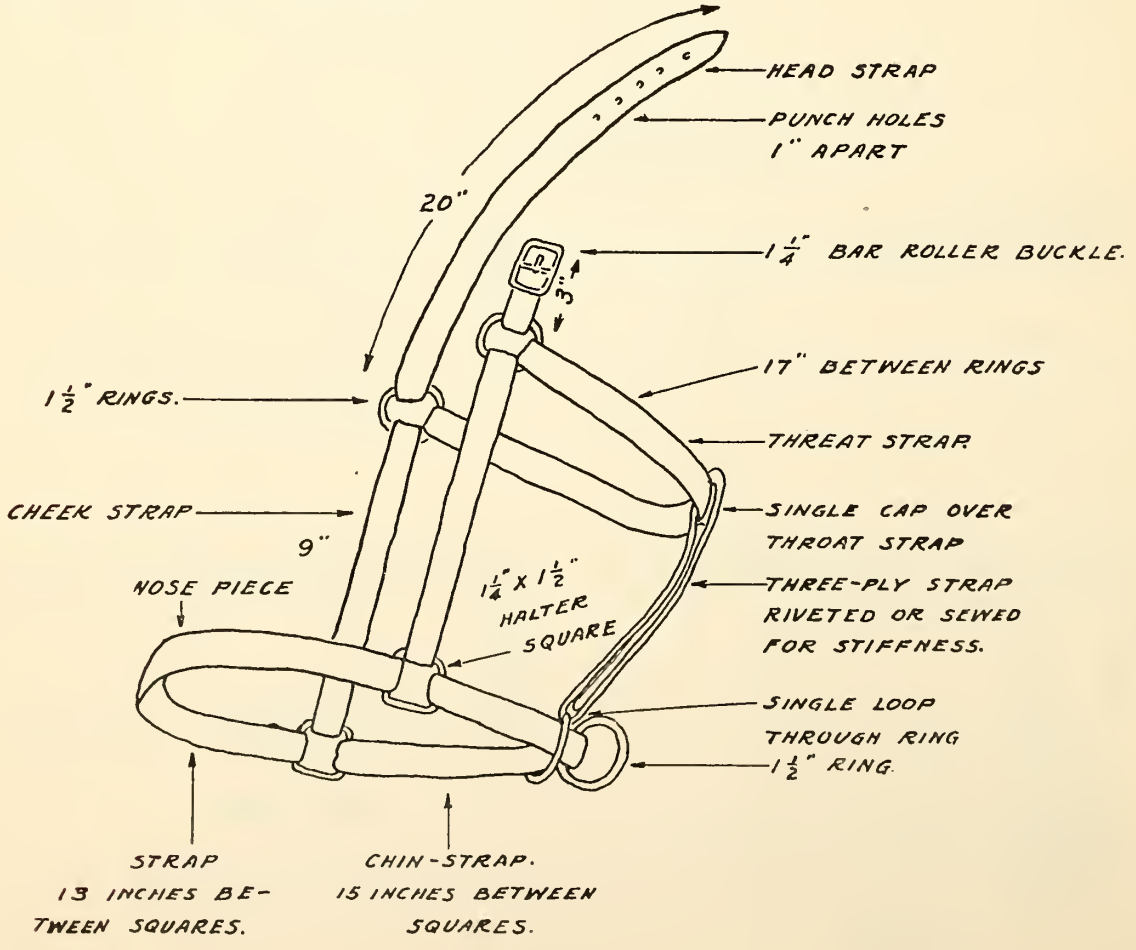
3. Cut 2 cheek pieces 1¼" x 12" each. Fold each 1¼" through top side of halter squares and sew or rivet. Then fold the other end of each strap 1¼" through a 1½" ring and rivet or sew.

4. Cut one head strap 1¼" x 21¼". Fold 1¼" through the ring on the off side and rivet or sew. Punch several holes in other end about 1" apart, beginning 3" from the end. Then round the end off.

5. Cut one strap 1¼" x 5½". Fold 1¼" through ring on near side and rivet or sew. Then fit the other end to a 1¼" bar roller buckle and rivet or sew. The center bar should be 3" from the ring when completed.

6. Cut the throat strap 1¼" x 19½". Fold 1¼" at each end through the two upper rings and rivet or sew. This throat strap must lie on the same side as the chin strap.

7. Cut chin strap 1¼" x 19". Fold through the ring on the chin strap through which the doubled strap passes and fold over the throat strap. This strap is folded in such a way that between the slip ring and the throat strap there are 3 layers of leather for stiffness, but the loops are single. Rivet or sew the 3 layers together. The stay strap should slip freely on the throat strap when completed.



Questions on Harness and Leather Work

1. How does the amount of harness repairs compare today with five years ago?

2. List the harness work that you have at home that needs attention now?

3. How could you improve the care of harness on your farm?

4. From where do we obtain neats-foot oil?

5. How should oil be applied to harness?

6. Compare sewing to riveting for splicing.

7. Why do we tear the sewing thread rather than cut it when making the thread?

8. What is the purpose of waxing the thread?

9. Should the thread be waxed before or after twisting?

10. Make a sketch of:

    (1) A split rivet

    (2) A tubular rivet

    (3) A rivet and burr

11. Why is the flesh side placed to the hair side when making a leather splice?

12. What parts of the hide are considered best?

    What parts are considered poor?

13. When do you think it would be practical for the average farmer to tan his own leather?

14. Compare the cost of home tanned leather to bought leather

15. What method would you use to clean and oil a saddle?

16. How would you suggest storing a saddle?

SHEET METAL

When we think of soldering, we think in terms of joining similar or dissimilar metal by means of some other metal or alloy which is usually softer and has a lower melting point than the metals joined together.

Solder is an alloy composed largely of two metals, tin and lead. These metals are combined in such a proportion as to make the desired kind of solder for the purpose needed. Metals that do not receive much heat can be joined together with a soft solder, where the wares are exposed to a higher temperature hard solder is needed. In speaking of hard and soft solders we mean solders that have a low and high melting point. Soft solder which is usually half tin and half lead melts at a temperature of 370° F. This is known as 50/50 solder. 40/60 and 45/55 are also common mixtures. The melting point of tin is 448° F., while lead melts at 621°, as these two properties are combined, the melting point is lowered.

Lead has a higher melting point than tin (Kent). The more tin that is added the softer is the solder. A mixture of one part tin and two parts lead melts at 441° F. (Kent).

Hard solders are alloys composed of brass, copper, lime, silver and gold. As these solders have a very high melting point they are not considered practical from a farmer's standpoint, since it requires a special torch which burns acetylene and oxygen to melt them. In some cases a good blow torch may be used.

Solder is sold in two forms, bar and wire. The wire is marketed in one to five pound spools, while the bars contain one pound each. Core solder is sold in wire form only. Sizes in which this solder may be obtained range from 240 thousandths outside diameter to 40 thousandths with two core sizes of flux. This type of solder carries the flux inside the wire and as the solder is melted, the flux is released and flows on the surface to be soldered. The most popular cores are rosin and acid. The advantage of the core solder is that it eliminates carrying on hand the fluxes needed for soldering and for small jobs it is very convenient to use.

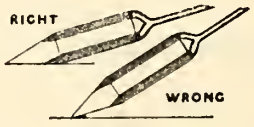
There are a number of patented solders and cements sold on the market that meet with only fair success. They may or may not contain the correct flux and are not dependable. Aluminum solder is sold on the market and gives very good results. It requires only heat and is applied by rubbing the bar of solder on the heated surface.

SOLDERING EQUIPMENT

It is necessary to have some means of heating the elements that are to be soldered. The materials must receive enough heat to make the solder flow. This may be done in two ways: by using an open flame directly on the work to be soldered and second, by transferring the heat from a flame to the work to be done by an ordinary iron. Where the open flame is applied, it is very difficult to con-

trol the heat and center it on the work to be soldered without damage to the surrounding parts. However, it may be used to a good advantage in "sweating" on work. The flame increases oxidation very rapidly and tends to remove the flux that may be applied.

The soldering iron is the best means of transferring heat as it is clean, easier to handle, produces a cleaner and more even job. The main disadvantage to the hand iron is that it loses its heat rapidly. But where several irons are kept in the fire work will continue with very little loss of time.



The electric soldering iron may be used to a good advantage where current is available. It maintains an even temperature. It must be left on the circuit while in use, which necessitates bringing the work to the shop. This iron is very convenient in soldering radio work. It carries a resistant unit in its body which generates heat and is delivered to the work through the conducting medium of a copper point or head. These heads are screwed on and are made in different sizes for different uses.

Types of Irons or Coppers

There are several different types of soldering irons, depending on the use for which the iron is designed. Most irons are pointed so as to allow the solder to follow the point of the iron and work in close places. The essential thing to consider in purchasing an iron is to get one large enough for the work on which it will be used. Joints that are found faulty are usually traced to the lack of capacity in soldering tools. Soldering coppers are

sold by the weight, the weight being given for two coppers. That is, a three pound copper means a pair of coppers, each weighing a pound and a half. Soldering irons are made of copper because it conducts heat readily. Irons should not be overheated, as this removes the tin and oxidizes the metal which requires retinning. The proper heat for the copper depends upon the type of work to be done. Heat travels very fast in copper and brass and would require more heating to melt the solder. An experienced tinner will test the temperature of the iron by holding it near his cheek. At no time should the copper be heated to a red heat.

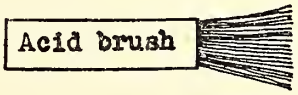
Soldering Fluxes

The purpose of the flux is to keep the materials from oxidizing previous to soldering, and to assist in flowing on the solder. The correct flux to be used is just as essential in soldering as clean surfaces and clean irons. The common fluxes used in soldering are muriatic acid (HCl), Chloride of Zinc ($ZnCl_2$) rosin, sal ammoniac, soldering pastes, tallow and borax.

Muriatic Acid

Muriatic acid or raw acid as it is sometimes called is the correct flux for galvanized iron and old iron. Care should be taken not to allow the acid to come in contact with parts of the metal that is not to be soldered, as it will cause it to rust.

Muriatic acid is also used on rusty metals to remove the rust and clean it. Where it is used in this way, it should be washed off before the correct flux is applied. Acid should be applied to the surface with a small brush or swab. These brushes may be made very easily as shown in Fig. below, with a small bit of binder twine and a piece of tin.



They last but a short time as the acid acts on them, but can be replaced with new ones.

Zinc Chloride

Zinc Chloride is made by cutting up metallic zinc into HCl. In making the acid, fill a quart jar about one-fourth full of HCl. Add a small piece of zinc at a time, as the acid will boil over. The zinc from old dry cells is found to be excellent for making zinc chloride. The chemical formula for the action of HCl on zinc is:

$$2\,HCl + Zn \rightarrow ZnCl_2 + H_2$$

After the acid has eaten all the zinc that it will take, it should be strained and placed in an air tight container.

Acids should not be placed in the same locker with tools, as the fumes given off will cause them to rust. It is well to have a separate wood cabinet for all soldering fluxes.

Zinc chloride is used as a flux on most metals except galvanized iron, and old zinc.

Rosin

Rosin is an excellent flux for new tin. It is also used in soldering electrical work such as radio sets, house wiring and so on. Acids should not be used in soldering work that carries an electric current, as the current passing through causes the wires to corrode the joints like the terminals on a car battery. Rosin core solder may be used to a good advantage in soldering wires. Rosin is the correct flux to use in soldering canned goods. It will not rust the can, and if a small bit should get into the can there will be no effect on the vegetables.

Sal Ammoniac

Sal ammoniac may be used as a flux, but it is harder to work than some of the other fluxes and is used almost exclusively for cleaning soldering coppers. It is sold in lumps and powdered form. A large lump is preferred to the powder. An excellent cleaner for irons may be made by placing a small lump about the size of a large marble dissolved in a cup of water. This makes about an 8% solution. The solution should not be made too strong as it will tend to remove the tin from the iron. Irons do not need to be tinned each time they are used. They may only need to be cleaned. The iron may also be cleaned by dipping it in zinc chloride.

Soldering Pastes

Soldering pastes contain several fluxes and may be used for doing most any kind of soldering work. The special electrician's soldering paste does not contain fluxes that will cause the joints to corrode. They usually contain a large amount of rosin. Pastes are harder for the amateur to use as they contain a fatty base and this necessitates a hotter copper to dry out the grease.

Tallow

Tallow is used on lead as it oxidizes faster than most any of the metals. Lead pipes are scraped and tallow is rubbed on. They may then be set aside until ready to solder.

TINNING SOLDERING COPPERS

It is necessary that the soldering copper be tinned. By tinning we mean coating the point of the copper with a coat of solder. If the point of the copper is tinned in working, solder will tend to adhere to the iron and follow it as it moves along the work. As a copper is exposed to the air it becomes oxidized. It must be well cleaned and a flux applied before solder will adhere to it. Below are three different ways of tinning a soldering copper:

No. I. (a) Heat the copper
(b) Clean by filing the point
(c) Rub copper on sal ammoniac, apply solder. By this method the copper must be very hot or good results will not be obtained.

No. II. (a) Heat the copper
(b) Clean by filing the point
(c) Place a small amount of rosin on bright tin and rub it with the iron applying solder.

No. III. (a) Heat copper
(b) Clean copper by filing point
(c) Rub on rosin or acid core solder

By using either of the methods above it will be found that after the copper has been cleaned by filing, better results will be obtained if the copper is dipped in zinc chloride which removes the oxide before applying the flux and solder. A hollowed brick may be used to a good advantage in applying the fluxes and solder in tinning the copper. After the copper has been tinned the excess solder should be wiped off on a piece of damp waste. Small coppers are usually harder to tin than larger ones as they lose so much of their heat while going through the process of tinning. A cup of sal ammoniac water should always be available for cleaning iron after heating.

Soldering Chart

METALS	CORRECT FLUXES				
	HCl	$ZnCl_2$	Rosin	Tallow	Elec. Paste
GALV. IRON	X				
NEW TIN			X		
LEAD				X	
OLD ZINC	X				
BRASS		X	X		
COPPER		X	X		
RADIO			X		X
IRON		X			
NEW ZINC		X			

General Essentials of Soldering

Most anyone can do good soldering if he will keep the essentials in mind.

(1) Metals to be soldered must be clean. This means free from dirt, grease and oxide.
(2) The correct flux must be used.
(3) The metals must receive enough heat to make the solder flow. This is one of the common faults of soldering. The workman sees the solder melt as it is applied to the surface but the surface being cold cools the solder and it fails to bond properly.

A Few Soldering Jobs That Occur on the Farm

1. Buckets
2. Milk cans
3. Radiators
4. Funnels
5. Gasoline cans
6. Canned fruit
7. Radio work
8. Poultry watering trough
9. Watering trough floats
10. Burst faucet
11. Burst pipes
12. Cooking utensils
13. Agate ware
14. Wash pans
15. Metal roofs
16. Lead pipes
17. Watering tanks
18. Overhead cistern

Common baking soda quickly neutralizes acid. It may be used to throw on spilled acid or a small quantity may be added to the water used in wiping the soldered joints to stop chemical action.

Questions on Soldering

1. What are two functions of a flux?

   .....

2. Of what metal is the soldering iron made?

   Why? .....

3. What is meant by "tinning" a soldering iron?

   .....

4. What happens if the soldering iron becomes too hot?.....

5. What flux should be used for soldering ignition wires? Why?.....

   .....

6. What precautions are necessary to secure a good job?.....

7. What do we mean by a 50-50 solder?.....

.....

8. What do we mean by core solder?

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9. What are the different kinds of core solder?

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10. How practical is core solder for the farmer?

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11. How does the cost of core solder compare to plain solder?.....

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12. What are the different methods of heating soldering coppers?.....

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13. What causes copper to corrode? Explain.

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14. How does hydrochloric acid affect zinc?.....

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15. Why do we need different size coppers?

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16. What are the common methods of cleaning a rusty piece of iron to be soldered?.....

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17. Why do we tin a soldering copper?.....

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18. When should the copper be tinned?.....

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19. What weight of copper is best suited for general repair work?.....

20. What precautions should be taken in operating the blow torch?.....

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21. What kind of gasoline should be used in the blow torch?.....

22. When the plunger valve and the pump does not work properly tell what may be the cause and how to repair it or renew the leather.

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23. List soldering jobs that you have at home and that need to be done now.

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PAN

Job Specification

To make a pan and solder the joints.

Materials and Equipment

Tin snips, solder, blow torch, coppers, cut acid (zinc chloride), raw acid (HCl), hammer, waste, sandpaper, file, rule, sal ammoniac, tin, copper and galvanized iron.

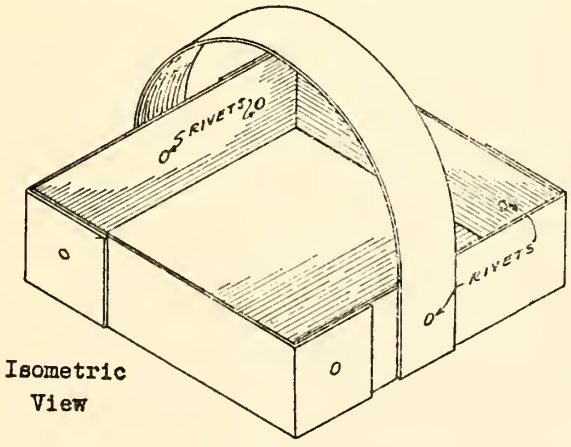
Procedure

Take a piece of galvanized iron and make a pan following the working drawings below.

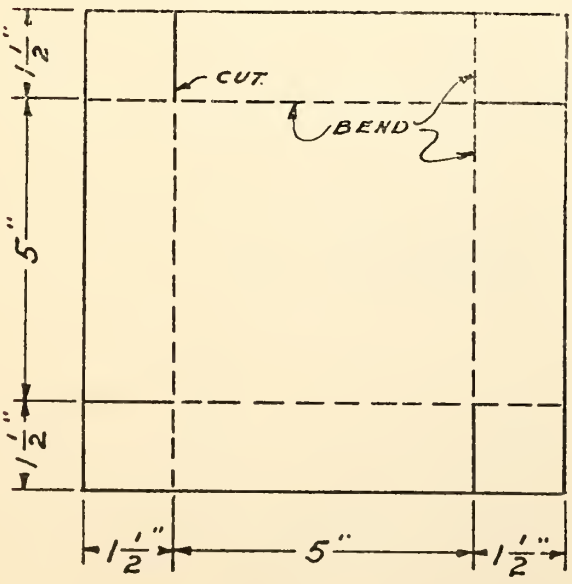
Make some zinc chloride by adding zinc to HCl.

Tin soldering coppers two different ways. (1) Grind or file the soldering copper; heat, dip in zinc chloride and rub on sal ammoniac, applying solder. Wipe off the excess solder. (2) Tin the copper by dipping in zinc chloride and rubbing the copper on resin applying solder. (Do not have copper too hot.)

When work is finished see that all equipment is put back in the proper place.



Isometric View



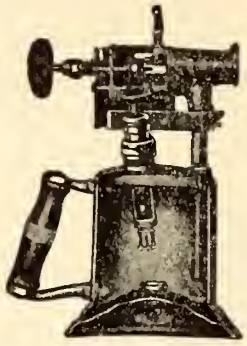
BLOW TORCH

Job Specification

To generate a blow torch.

Materials

Blow torch and gasoline.



Blow Torch

Procedure

1. Fill tank nearly full with clean "regular" gasoline, out of a clean receptacle. Do **not** use "high test" or "treated" fuel. Strain through chamois, if possible, to insure getting clean fuel.
2. Screw in filler plug—by using ordinary laundry soap on threads a better seal can be secured between lead washer on plug and tank seat without using excessive force or pressure. Too much force will ruin lead washer and will strip threads on filler plug.
3. Drop a little lubricating oil through the hole in top of pump cap. Repeat once every week. This keeps leather washer moist and insures long life. Pump about ten strokes of air into tank—this is enough to start. Gasoline supply valve should be closed.
4. Turn gasoline supply control valve wheel to left slightly. This allows gasoline to flow slowly into priming cup. When nearly full shut off control valve. Do not let gasoline overflow priming cup—if it does be sure to wipe tank dry before lighting fuel in priming cup.
5. Light fuel in priming cup.
6. When gasoline in priming cup is nearly burned out open control valve slightly (by turning to left) and if necessary light burner flame. (Hold lighted match close to air vent holes in combustion chamber and not in front of burner nozzle.) An intense blue flame should result. In extremely cold or windy weather one filling of the priming cup may not thoroughly heat the vaporizing veins. If gasoline instead of gas comes out of burner nozzle refill priming cup, shut off control valve and relight fuel in priming cup.
7. To increase flame volume increase pressure in tank and regulate control valve. Avoid too much pressure. Burner cannot be throttled down to produce low flame when there is excessive pressure in tank.
8. If it is desired to burn kerosene the burner should be fitted with a Kerosene Jet block and a piece of asbestos wick placed in priming cup. The torch may then be operated successfully according to the above directions.

DUST PAN

Job Specification

To make a dust pan.

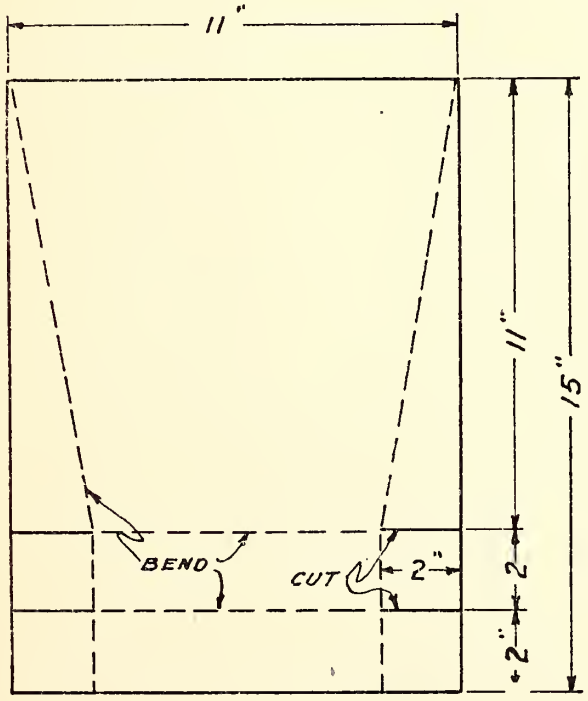
Materials and Equipment

Solder, snips, coppers, cut acid, HCl, hammer, waste, sand paper, ruler, one piece of galvanized metal 11" x 15".

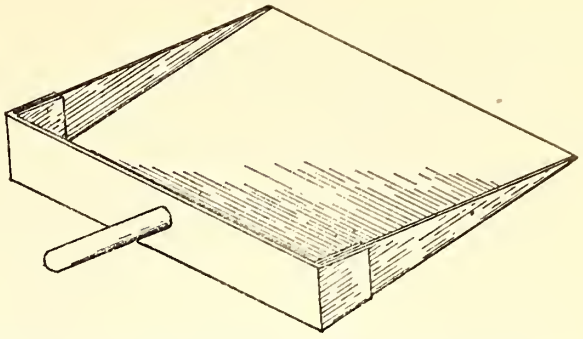
Procedure

Take a piece of galvanized iron and make a pan following the drawings below. The metal should be doubled on the back to reinforce the pan. The corners should be riveted and soldered. Make the handle out of a car spoke or broom handle. The handle should be put on with a screw or may be nailed on with 3d common nails. The handle may also be bolted on.

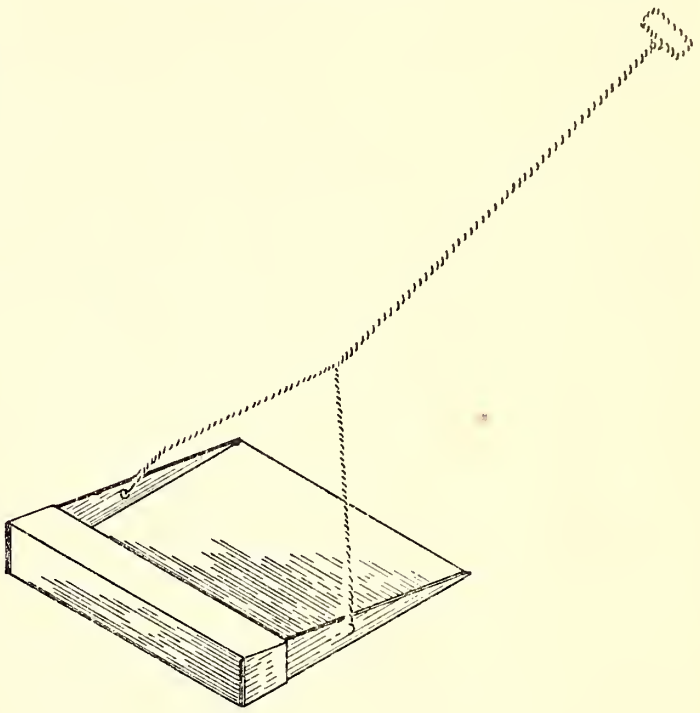
When the pan is completed it should be given a coat of black enamel.



STOCK.



Method of attaching handle, and making pan.



1. What uses do you have for a dust pan?

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2. What would be the advantage of a dust pan with a long handle over one with a short handle? .....

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3. How much can you save on a home made dust pan over a boughten one?.....

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FUNNEL

Job Specification

To make a funnel.

Material and Equipment

Solder, snips, coppers, dividers, flux, sheet metal, rule, and torch.

Procedure

Make a funnel with the following specifications, vertical height 3½", diameter of top 5", outlet ½", spout 2".

Funnels of other dimensions may also be made.

The body and spout are merely two frustrums of cones.

(1) Make a side drawing of the funnel and extend the side lines of the body and spout until they intersect the center line at M and G. For the pattern for the body with g as a center and radii equal to GF and GE, describe the arcs ee and ff of the pattern. On the arc ee step off four times the number of spaces contained in the quarter plan C; then draw lines to the center line g.

(2) Develop the spout in the same manner as the body was developed.

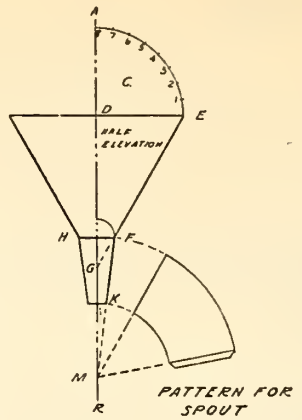
(3) Notch the corners as shown in the drawings.

(4) Place the body part of the funnel in a vise or folder and bend for the lock seam. Place the work over the horn of the anvil and with the groover lock the seam.

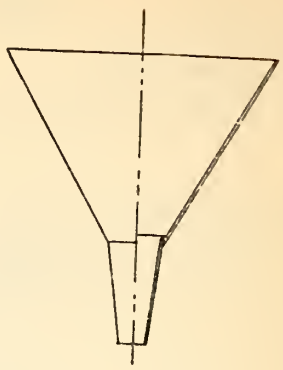
(5) Shape the spout and drop it into the outlet of the funnel to get a good fit. Solder the outside seam of the spout, remove it and with a punch flare the edge. Drop the spout back into the funnel and solder.

References

Sheet Metal Worker's Manual—Broemel.



PATTERN FOR SPOUT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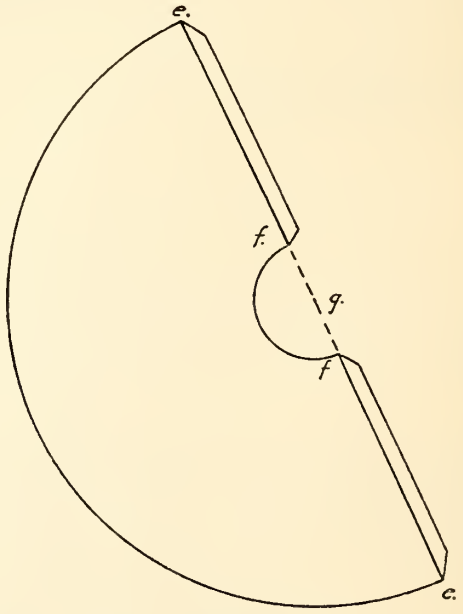
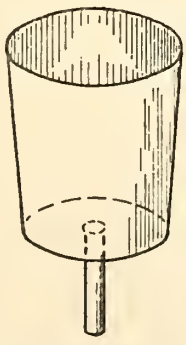


PATTERN FOR BODY.

SUGGESTED SHEET METAL JOBS

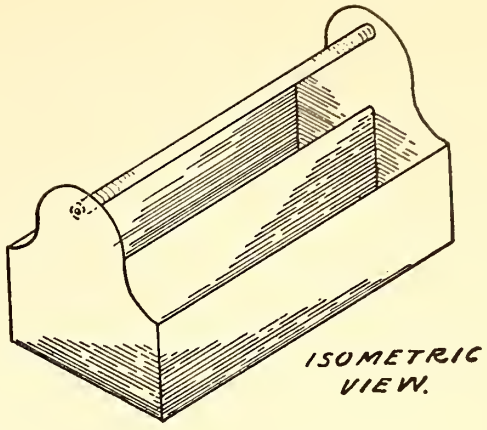

BUCKET WITH SPOUT

QT. OIL CAN WITH SPOUT

TOOL CARRIER

Job Specification

To construct a sheet metal tool carrier.



Materials and Equipment

1 piece round wood 15″ long

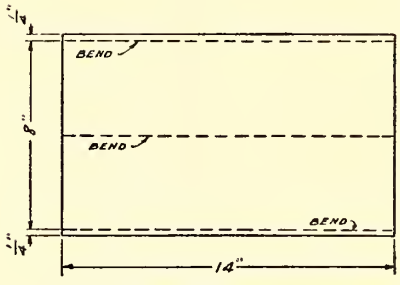
1 piece sheet metal 15″ x 30″ -28 gauge

Snips, solder, coppers, acid, torch, and waste.

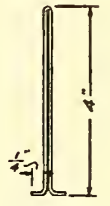
Procedure

1. Lay out stock according to plans. Care should be taken to cut lines correctly.
2. Bend on dotted lines.
3. Bend corners, place in one rivet and solder.
4. Form partition and solder bottom and ends.
5. Place reinforcing strips on side.
6. Put in handle.
7. Paint the carrier with enamel.

NOTE: More partitions may be placed in the carrier if needed and used for a nail and screw tray.



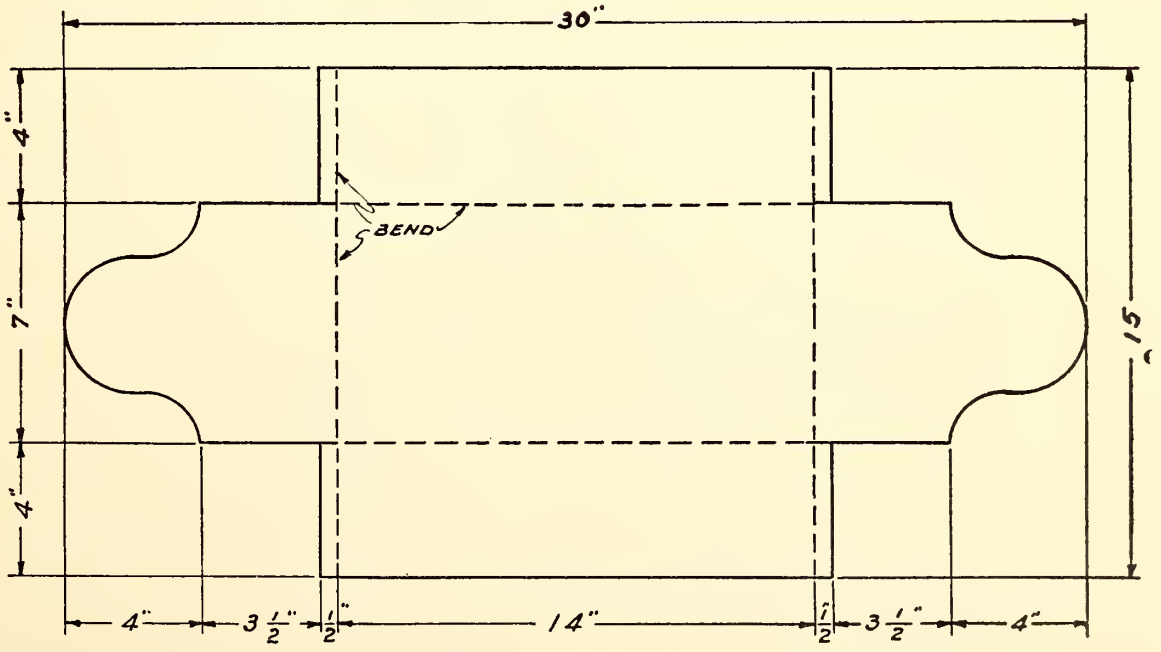
MATERIAL FOR PARTITION



DETAIL OF PARTITION

References

Sheet Metal Worker's Manual—Broemel.



MATERIAL FOR BODY.

MAKING A COLD CHISEL

Job Specification

To learn how to make a cold chisel and temper it.

Materials and Equipment

Forge, tongs, tool steel, hammer, and water.

Procedure

The stock should be heated to a yellow heat, forged into shape and finished as smoothly as possible. Be sure not to overheat it.

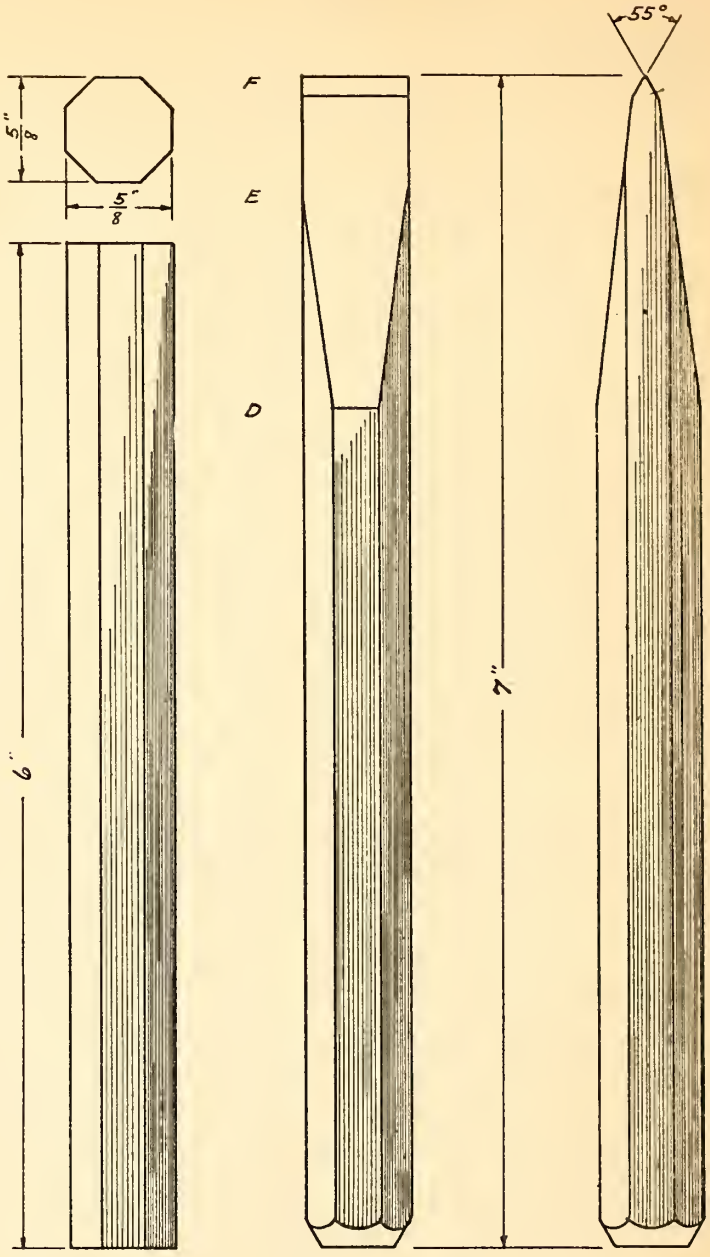
In tempering, the chisel should be heated to a cherry red from point F to line D. Be careful not to overheat the point. In case the point heats too rapidly, withdraw the chisel from the fire and cool in the air—not water. When properly heated, the point should be immersed in water to line E, allowed to cool and then withdrawn. Polish one side of the chisel with sandpaper to enable you to watch the heat travel in tempering.

The heat in the body of the chisel will slowly raise the temperature of the cooled portion of the chisel and cause the polished surface to take the following colors successively: yellow, brown, and purple. When the tip is dark purple, almost blue, plunge the entire chisel in water. The point of the chisel should angle at about 55°.

Note: Good punches and chisels may be made from old car axles if properly tempered.

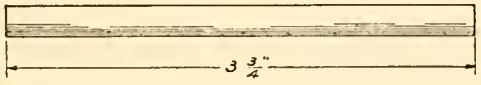
The chisel should always be dressed with a mill file.

Oiling will prevent rusting.

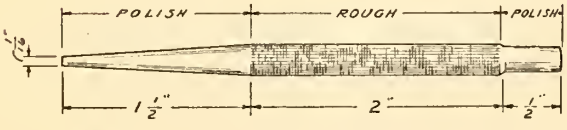


COLD CHISEL

NAIL SETS AND CENTER PUNCHES



STOCK



NAIL SET

CENTER PUNCH

1. List four uses for a cold chisel.

   _____ _____

   _____ _____

2. What parts of a car would be suitable for making cold chisels or punches?_____

   _____

3. Why is correct tempering essential?_____

   _____

HAY HOOK

Job Specification

To make a hay hook.

Materials and Equipment

1 piece mild steel 16″ long.

1 piece of ¾″ pipe 5″ long.

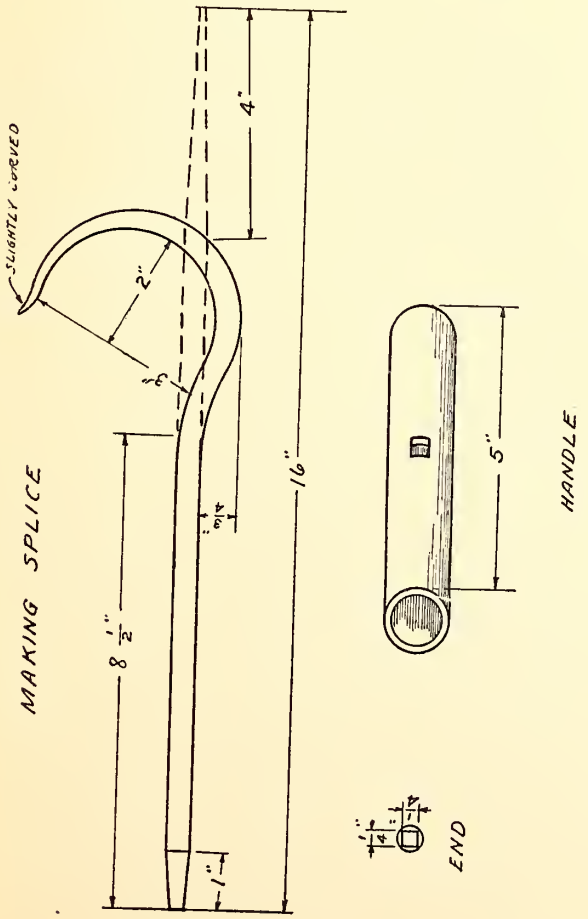
Procedure

(1) Cut a piece of 7/16″ mild steel 16″ long. Heat the material to a deep yellow and forge out one end to a point. The material should slope back three inches. Cut off about ¼″ of the end.

(2) Forge a square shoulder on the other end of the material. It should be forged back about 1″. The end should finish about ¼″ sq.

(3) Shape the hook according to the drawing.

(4) Bore a ¼″ hole in the piece of pipe in the center. Use a square punch and fit the handle to the hook. Brad the hook on the handle.



CLEVIS

Job Specification

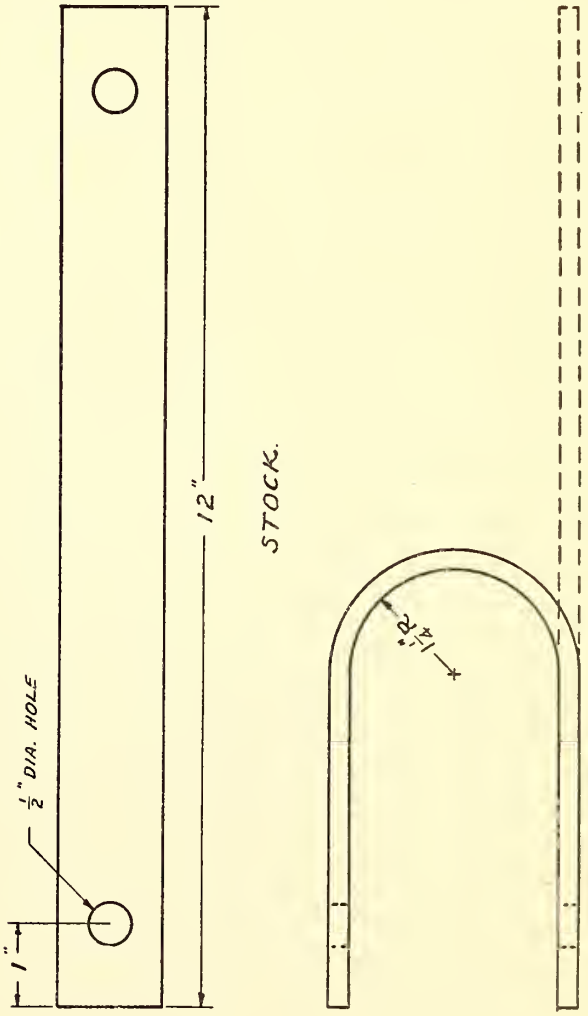
To make a clevis.

Materials and Equipment

1 piece of ¼″ x 1¼″ x 12″ iron.

Procedure

Cut a piece of material according to the measurements below. Bore a ⅜″ hole one inch from each end. Heat the material and shape according to the drawing below. Use a center punch to start the hole for boring.



NOTE: When using old car springs to make a clevis it will be necessary to punch a hole through the material while it is hot.

FIRE SHOVEL

Job Specification

To make a fire shovel.

Materials and Equipment

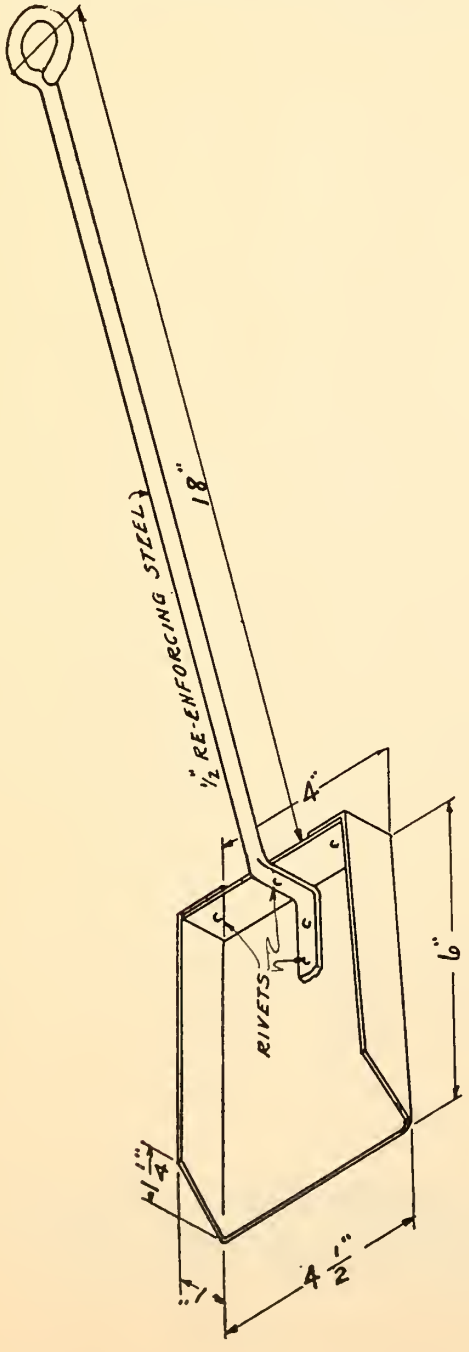
1 piece ½″ rod 24″ long.

1 piece heavy sheet metal (14 to 20 gauge) material from barrel tops or car fenders can be used.

Cold chisel, ball peen hammer, and rivets.

Procedure

1. Cut piece of sheet metal 7″ x 6½″.
2. Lay out lines to be cut as shown in drawing.
3. Place metal in vise and bend up sides and back 1″.
4. Place two rivets in corner.
5. Form handle and rivet in center of shovel.



Questions on Blacksmithing

1. What are the common blacksmithing jobs that are done on your farm?.....

2. How much do you estimate is spent on your farm each year for blacksmithing work done in town?.....

3. How much do you consider the average farmer in your community could save by having his own blacksmith shop?.....

4. Make a list of the blacksmithing equipment that you need for your farm that you do not have.....

5. What would be the advantage of doing your blacksmithing at home over having it done in town?.....

MACHINERY REPAIR

Job Specification
To overhaul and repair farm machinery. (This may be done either at home or at the school shop.)

Material and Equipment
Hammer, wrenches, pliers, punches, and chisels.

References
Farm Machinery—Smith.
Agricultural Machinery—Davidson.
Care and Repair of Farm Machinery, by John Deere Plow Co.
Farm Mechanics Text and Handbook, Chap. XL —Cook, Scranton & McColly.

Procedure
Inspect farm machinery for worn, bent, broken and loose parts and repair same.

Machine .....

Trade Name..... Age.....

General Condition.....

Worn Parts	Replacements Needed No.	Name	Cost

Cost of repairing: Labor.....

Parts..... Total..... Value of machine before repairing..... Value after repairing.....

Questions

(1) Is this machine obsolete?.....
Would it pay to replace with a new model?
.....

(2) Has the machine been well cared for?.....
..... How?.....

(3) Housing provisions available.....

(4) Does the machine need paint?.....

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..... How?.....

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(4) Does the machine need paint?.....

FARM PLUMBING

The home water supply is incomplete without good plumbing. There is nothing that contributes more to the comfort and convenience of the home than a well distributed water supply. The distribution of the water is just as important as its source.

Piping the water to different parts of the place is a great labor saving as well as a saving of time. For the farmer to place running water on the farm it becomes necessary for him to know something about the fundamentals of plumbing.

It is said that America has the best plumbing of any nation in the world, but we are talking principally of modern plumbing in the city.

When we think of the low cost of putting in plumbing in the farm home, we wonder why more farmers do not have good plumbing. There is nothing that can be placed in the home, with such little cost, that will equal the satisfaction that can be had from a modern plumbing system.

Plumbing should be installed with the idea of permanency, sanitation, and service. Plumbing that is not properly installed may easily become unsanitary and hibernate many disease germs, which may result in much sickness in the family. When installing a system, the pipes should be put down so that they may not need to be removed and replaced. If the pipes are too small, it may mean that the proper amount of water needed cannot be furnished.

Plumbing today is largely the assembling and installing of manufactured products that may be bought from the local dealer or from a mail order house. It requires less skill than it did several years ago because it has become more simple. Many inexperienced farmers can do their own plumbing if the layout is simple. On large jobs it may be necessary to secure an experienced plumber to do the work.

Most any farmer can install pipe for running water in the kitchen. Naturally, a sink should be installed first. The plumbing to the bathroom can be installed later.

A kitchen sink, on an average, can be installed for about $50.00. For a complete installation of plumbing in a farm home the cost would be about $250.00.

Pipe Fitting

The pipe commonly used for steam, gas, and water lines is sold as "wrought iron" pipe, although it is usually made of mild steel, a material very similar to wrought iron, but cheaper and just as good except where the pipe is welded.

Wrought iron pipe is sold in three weights: "standard", "extra strong", and "double extra strong." The standard is used for all common work.

The size of pipe is measured and expressed as the inside diameter in inches of the standard pipe. The stronger grades have the same outside diameter as the standard but the thicker pipe walls make the inside diameter less. Pipes over 12 inches have size expressed in outside diameter and are known as O. D. pipe.

Wrought iron pipe up to 1½" to 2½" is made with butt welded joints. Larger sizes are made with lap welded joint. Seamless tubing is used where great strength and light weight are desired, or where it is difficult to test pipe for leaks after it has been installed.

"Black" pipe is wrought iron pipe without any coating. "Galvanized" pipe is wrought iron pipe that has been coated with zinc to prevent rusting. Galvanized pipe should be used for water pipe, especially where the pipe passes through the ground or through damp places. Black pipe is used for steam and gas.

Pipe fittings are the parts used to fasten the length of pipe together. The size is given as the size of the pipe on which the fitting is used. If a fitting has openings of different sizes, the size of each opening is given in the proper order. In describing a tee, for instance, give run first, then side outlet, viz: 1" x ¾" x 1".

Pipe fittings are made of malleable iron or cast iron, both being made in the black or galvanized finish. Malleable fittings are made plain or beaded. Plain fittings are used for gas piping, while beaded fittings are used for steam and water pipe. Cast iron fittings are made with either flat or round bead and are commonly used for steam fitting.

A thin oil, such as lard oil, should be used in cutting threads to make the die turn easier and to prevent the breakage of threads or dies.

IDENTIFICATION OF PIPE FITTINGS

Job Specification

To study and identify the different kinds of pipe fittings used on the farm.

Materials and Equipment

Display board with 20 pipe fittings numbered or tagged.

Procedure

Name the pipe fittings, giving size, use, make sketch, and check against instructor's corrected list.

Name	Size	Use	Sketch	Kind of Material	Grade
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					

PIPE THREADING

Job Specification

To cut and thread pipe.

References

Farm Engineering—Robb and Behrends.
Farm Plumbing—U. S. D. A. Bul. No. 1426.

Materials and Equipment

Pipe cutter, pipe stock and dies, cutting oil, vise, and reamer.

Procedure

(1) Cut a piece of pipe, size....., length..... Care should be taken to avoid side thrusts when operating the pipe cutter.

(2) Ream out the burr made by the pipe cutter with a reamer or half round file.

(3) Select the proper size die and guide to fit the pipe. If a solid ratchet type die is used, be sure it carries the right size cutters and is properly adjusted.

(4) Place the die over the pipe and hold the handles of the stock at right angles to the length of the pipe to insure a straight thread. Press the die firmly on the pipe and rotate the stock to the right. Apply lard oil or cutting oil freely to the cutting lips of the die.

(5) Remove dies and examine the thread.

Questions

1. How is pipe measured?.....

.....

2. What are the materials that pipe is usually made from?.....

.....

3. Define "Die", "Stock" and "Tap".....

.....

4. What is the purpose of pipe cement?.....

.....

5. Upon what will the friction in pipes depend?

.....

6. Distinguish between fittings and fixtures.

.....

PIPE FITTING

Job Specification

To do a job of pipe fitting.

References

Mechanical Engineer's Handbook
Wholesale hardware catalogs.
Farmers' Bulletin No. 1426.
Farmers' Bulletin No. 1460
Cornell Extension Bulletin No. 50

Procedure

Make up the pipe fitting exercise assigned according to the specifications given by the instructor. When exercise is complete, present it to instructor for inspection and testing. Make a drawing of completed exercise showing all dimensions.

To determine the exact length to cut a pipe, lay the pipe and fittings, properly spaced, on a bench or floor, and then mark the pipe, making due allowance for the threaded ends that will screw into the fittings.

1. In general, what are the differences between water pipe fittings and steam fittings?.....

.....

2. Distinguish between "coupling" and "union".

.....

3. Name two types of unions and explain difference.....

.....

4. What other methods are used to connect pipes? .....

.....

5. Explain "close nipple," "short nipple," and "long nipple.".....

.....

.....

6. Explain how you could make a short or close nipple with an ordinary pipe die.....

.....

.....

WATER SYSTEMS

Job Specification

To make a study of water systems.

References

U. S. D. A. Farmers' Bulletin 1448.
Red Jacket Company (catalog), Davenport, Ia.
Goulds Pump Co. (catalog), Seneca Falls, N. Y.
Farm Mechanics Text and Handbook, Chap. XXX—Cook, Scranton & McColly.

1. Make a list of all the types of water systems found in your community.

1._____ 2._____ 3._____

4._____ 5._____ 6._____

2. What is the name of the farmer in your community who has the most up-to-date system?

_____

Describe the system below.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

3. Is there sufficient wind in your community to successfully operate a windmill?_____

If not, how might it be supplemented?_____

_____

5. Make a drawing of a pitcher pump showing the valves. (Page 26, Bulletin 1448.) Explain how it works.

Pitcher Pump

6. About what is the maximum height that a pitcher pump will lift water?_____

7. Give the advantages and disadvantages of each of the two types of deep well cylinders.

Fig. 1

Fig. 2

_____

_____

_____

_____

_____

HOME WATER

Job Specification

Study of Home Water Conditions.

References

U. S. D. A. Bulletins 1448, Farmstead Water Supply; and 1426, Farm Plumbing.

Answer the Following Questions

1. What is the source of your home water supply? .....

.....

2. Is well safeguarded from contamination?

..... How?.....

.....

3. How many gallons of water are required for each per day (1448 - page 7).

Horses and mules.....Sheep or hogs.....

Average daily consumption in the modern home.

.....

4. How many gallons of water are used in your home each day?.....

5. How many gallons used for stock on your farm per day?.....

6. Describe a dug well.....

.....

7. Describe a bored well.....

.....

8. Describe a driven well.....

.....

9. Describe a flowing well.....

.....

10. Give five reasons why a good supply of water will aid in making a living on the farm.

1. .....

2. .....

3. .....

4. .....

5. .....

11. Make a sketch showing how and where the water is piped on your own farmstead.

12. Make a complete sketching showing how you would like to pipe your own farmstead. Use graph paper on next page.

* * * * * *

Job Specification

To study water storage.

References

U. S. D. A. Farmers' Bulletin 1448, Farmstead Water Supply, pages 32-36.

1. What are the different kinds of overhead storage tanks being used?

1..... 2..... 3.....

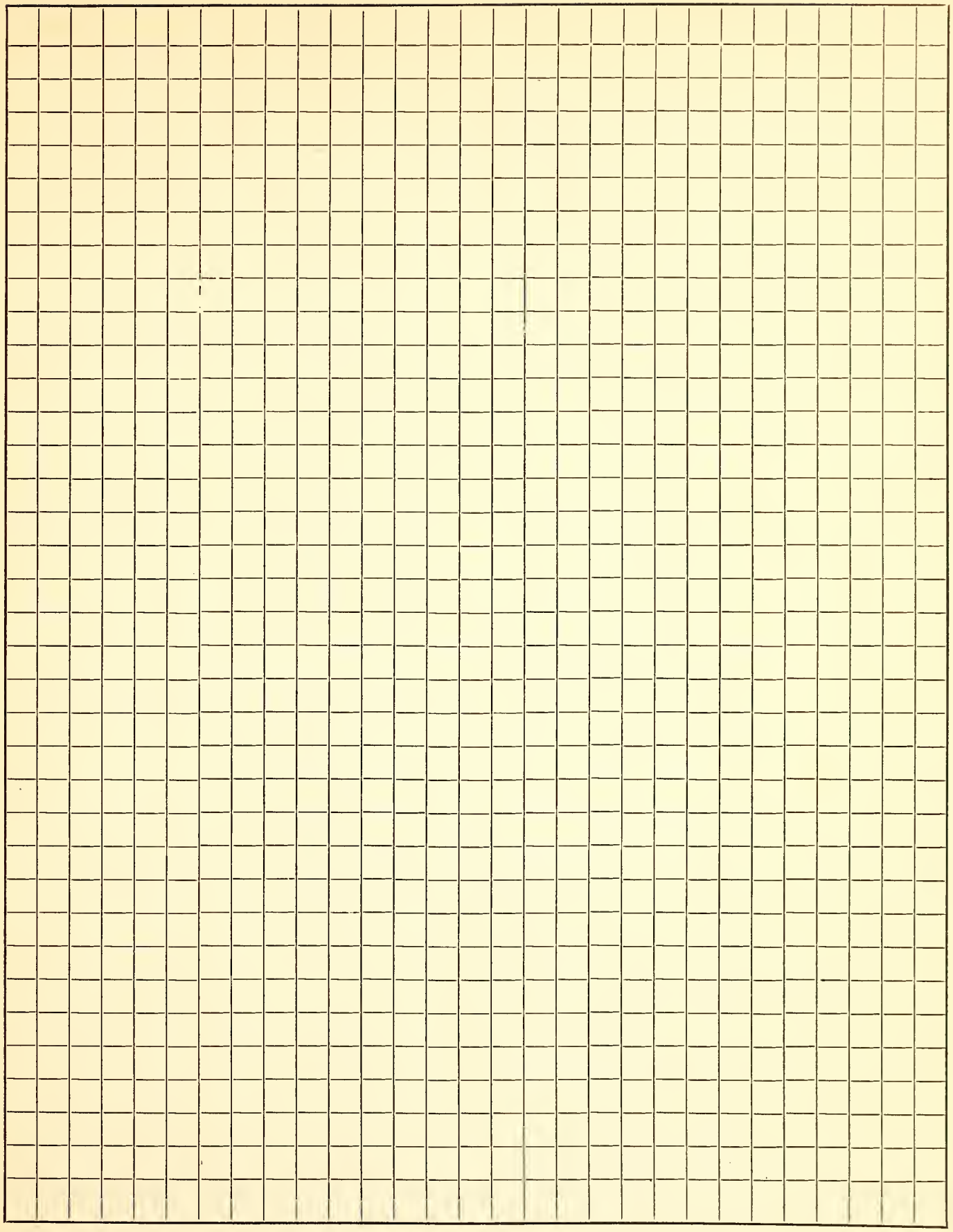
4..... 5.....

2. How many gallons of water would a round tank hold if it has an inside diameter of 8 ft. and a height of 10 ft.? Show work below:

3. How many gallons of water would a tank 8 ft. square and 10 ft. high hold?

Water Requirements of Animals

Horse	7 to 10	gallons daily, average about 8½
Cow	6 to 10	gallons daily, average about 8½
Hog	2 to 3	gallons daily, average about 2½
Sheep	1 to 2	gallons daily, average about 1½
Person	25 to 50	gallons per day, including that used for dishwashing, bathing, etc.



CONCRETE WORK

Job Specification

Estimating quantity of cement, sand and gravel for a given concrete job.

Aggregates used in making concrete for farm use vary a great deal as to size and shape. Due to this variation some mixes require more or less sand in proportion to the gravel. It is always necessary to use enough sand to separate the large aggregate. This assures a workable mixture.

The common mixtures used on the farm will usually run 1-2-3, 1-2-4, 1-2½-2½, or 1-3-5, depending upon the kind of material used and the strength of the concrete desired.

When estimating material needed for a given job, one must keep in mind that it requires about 42 cubic feet of cement, sand and gravel to make one cubic yard of concrete, or 27 cubic feet. The cement and sand enter the pores of the gravel and hence the total volume is decreased.

Fuller's Formula

$$\frac{42}{\text{cu. ft. cement} + \text{cu. ft sand} + \text{cu. ft. gravel}}$$

equals the number of sacks of cement needed for a cubic yard of concrete (27 cubic feet).

Example:

$\frac{42}{1 + 2 + 3}$ = 7 sacks of cement per cubic yard of this kind of concrete, where 1-2-3 is the mixture.

$\frac{42}{1 + 2 + 4}$ = 6 sacks per cubic yard, where 1-2-4 is the mixture.

$\frac{42}{1 + 3 + 5}$ = 4.44 sacks per cubic yard, where 1-3-5 is the mixture.

After the amount of cement is figured per cubic yard, then figure the number of sacks needed for the job.

If the mixture is 1-2-4, then 6 sacks per cubic yard will be required.

6/27 equals the amount of cement needed for one cubic foot of concrete. In case you have 50 cubic feet of concrete to make, then $6/27 \times 50/1$ equals sacks of cement needed for the job, or 11.1 sacks.

In this case the mixture is a 1-2-4. Then you would need 22.22 cubic feet of sand and 44.44 cubic feet of gravel.

The "Ten Per Cent Method" for Calculating Materials

1. Deduct 10% from the total volume (in cubic feet) of concrete to be made. This will be the amount of gravel needed.

2. If the mixture is 1-2-4 then half the amount of gravel will be the amount of sand needed.

3. One-fourth of the volume of gravel or one-half of the amount of sand will be the necessary amount of cement (in cubic feet or sacks) needed.

Note: This method can be used for quick calculation and serves for most farm jobs.

* * * * * *

CONCRETE PROBLEMS

Job Specification

To solve problems on concrete.

1. Using a 1-2-3 mixture, figure the amount of material needed to construct a side walk with dimensions as follows: 4″ thick, 5′ wide, and 100′ long.

Answer: Sacks cement..... Cu. ft. of sand.....

Cubic ft. gravel.....

2. Using a 1-2-4 mixture, figure the amount of materials needed for barn foundation 20′ wide and 24′ long. The foundation to be 6″ wide at top, 18″ wide at the bottom and 24″ high.

Answer: Sacks cement..... Cu. ft. sand.....

Cu. ft gravel.....

3. If Portland cement is 80c per sack, and sand and gravel is $2.00 per yard, what would be the cost of each of the above jobs?

Problem No. 1: Cost.....

Problem No. 2: Cost.....

4. Figure the amount of materials needed for a concrete stepping stone 3″ thick, 18″ wide and 24″ long, using a 1-2-3 mixture.

Answer: Sacks of cement.....

Cu. ft. sand.....Cu. ft. gravel.....

5. What are the things found in sand that make it undesirable for use?.....

.....

.....

6. Describe a good sand for concrete work on the farm.

.....

HOW TO USE TABLES FOR CALCULATING QUANTITIES

Problem 1:

What quantities of materials are required for a monolithic concrete foundation wall 34 feet square, outside measurements, 12 inches thick, 7 feet high, with a footing 12 inches thick and 24 inches wide, using a 1-2¼-3 mixture in the wall and a 1-2¾-4 mixture in the footing?

Solution:

The wall contains 924 square feet of surface, 12 inches thick, deducting for duplication at corners.

Referring to table below under 1-2¼-3 mixture for 12-inch walls, 23.1 sacks of cement are required for each 100 square feet of surface. Dividing 924 by 100 gives the number of times 100 square feet are contained in the total wall surface and multiplying this result by 23.1 gives the total number of sacks of cement required. Similar calculations are made for the fine aggregate and the coarse aggregate in both the wall and the footing, noting that the width of the footing, 24 inches, is twice the 12 inch thickness.

$$\frac{924\times 23.1}{100}=214 \text{ sacks cement.}$$

$$\frac{928\times 51.8}{100}=479 \text{ cubic feet fine aggregate.}$$

$$\frac{924\times 70.4}{100}=651 \text{ cubic feet coarse aggregate.}$$

The footing contains 264 square feet of surface, 12 inches thick, deducting for duplication at corners, or 264 cubic feet.

$$\frac{264\times 18.5}{100}=49 \text{ sacks cement.}$$

$$\frac{264\times 51.8}{100}=137 \text{ cubic feet fine aggregate.}$$

$$\frac{264\times 74}{100}=196 \text{ cubic feet coarse aggregate.}$$

Total materials required for footing and wall: 263 sacks cement, 616 cubic feet fine aggregate; 847 cubic feet coarse aggregate.

QUANTITIES OF CEMENT, FINE AGGREGATE AND COARSE AGGREGATE REQUIRED FOR ONE CUBIC YARD OF COMPACT MORTAR OR CONCRETE

MIXTURES				QUANTITIES OF MATERIALS			
				Fine Aggregate		Coarse Aggregate	
Cement	F.A. (Sand)	C.A. (Gravel or (Stone)	Cement in Sacks	Cu. Ft.	Cu. Yd.	Cu. Ft.	Cu. Yd.
1	2	—	12	24	0.9	—	—
1	3	—	9	27	1.0	—	—
1	1	1¾	10	10	0.37	17	0.63
1	1¾	2	8	14	0.52	16	0.59
1	2¼	3	6¼	14	0.52	19	0.70
1	2¾	4	5	14	0.52	20	0.74

1 sack cement = 1 cu. ft.; 4 sacks = 1 bbl.

MATERIALS REQUIRED FOR 100 SQ. FT. OF SURFACE FOR VARYING THICKNESSES OF CONCRETE OR MORTAR

Thickness of Mortar or Concrete (Inches	Amount of Mortar or Concrete (Cu. Yd.)	Proportions								
		1-2			1-3			1-1-1¾		
		C. (Sacks)	F.A. (Cu. Ft.)	C.A. (Cu. Ft.)	C. (Sacks)	F.A. (Cu. Ft.)	C.A. (Cu. Ft.)	C. (Sacks)	F.A. (Cu. Ft.)	C.A. (Cu. Ft.)
⅜	0.115	1.4	2.8	.....	1.0	3.0	.....	.....	.....	.....
½	0.15	1.8	3.6	.....	1.3	4.0	.....	.....	.....	.....
¾	0.23	2.7	5.4	.....	2.0	6.0	.....	2.3	2.3	3.9
1	0.31	3.7	7.4	.....	2.7	8.1	.....	3.1	3.1	5.3
1¼	0.38	4.5	9.0	.....	3.3	10.0	.....	3.8	3.8	6.5
1½	0.46	5.4	10.8	.....	4.0	12.0	.....	4.6	4.6	7.8
1¾	0.54	6.4	12.8	.....	4.7	14.1	.....	5.4	5.4	9.2
2	0.62	7.3	14.6	.....	5.4	16.2	.....	6.2	6.2	10.5
		1-1¾-2			1-2¼-3			1-2¾-4		
3	0.92	7.5	12.9	14.7	5.8	12.9	17.5	4.6	12.9	18.4
4	1.24	10.0	17.3	19.9	7.8	17.3	23.6	6.2	17.3	24.8
5	1.56	.....	.....	.....	9.8	21.7	29.6	7.8	21.8	31.2
6	1.85	.....	.....	.....	11.5	26.0	35.2	9.3	26.0	37.0
8	2.46	.....	.....	.....	15.4	34.4	46.8	12.3	34.4	49.3
10	3.08	.....	.....	.....	19.3	43.2	58.5	15.4	43.2	61.6
12	3.70	.....	.....	.....	23.1	51.8	70.4	18.5	51.8	74.0

C = Cement in Sacks. F.A. = Fine Aggregate (Sand). C.A. = Coarse Aggregate (Pebbles or Broken Stone).
Quantities may vary 10 per cent either way depending upon character of aggregate used. No allowance made in table for waste.

SIDEWALKS

Job Specification

To study correct methods used in sidewalk construction and build same.

Materials and Equipment

Cement, water, sand, pebbles, oil, mixing board, measuring box, shovel, trowel, float, edger, 2″ x 6″ form board, and braces.

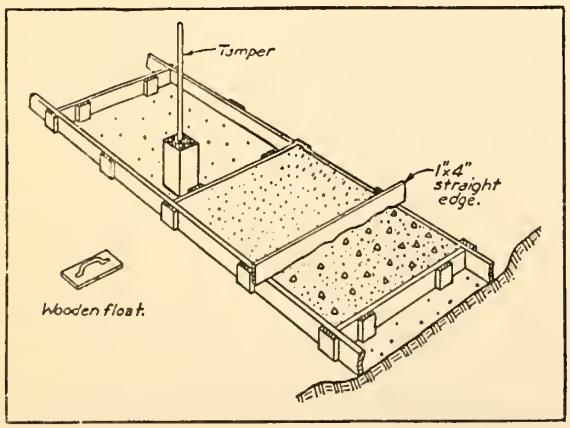
Reasons for the Job

Sidewalks are among the most useful improvements which can be built around the home. Concrete is now accepted as the ideal sidewalk material. When properly built, concrete walks meet all the requirements of a good footway. They are durable, smooth without being slippery, easy to clean, and are pleasing to the eye. The appearance of the home grounds can be greatly enhanced by building the walks in graceful curves around trees and shrubbery. Colored concrete walks are also attractive.

Procedure

The first step in the construction of the walk is to prepare the base. If the soil on which it is to be laid is well drained, the concrete can be placed directly on it, after it has been well compacted. If the soil is not well drained, a six-inch sub-base of well compacted, clean, coarse gravel, or clean cinders should be provided.

Thickness of walks vary from four to six inches. If used only as a walk, four inches is usually thick enough, but if heavy vehicles are likely to be driven over the concrete, the thickness should be six inches. The width to make the walk will vary with its location and its use. Main pathways from the street to the house entrance should be rather wide; four to five feet is a good width. Walks on the side or rear of the house leading to the garage and other buildings or through the garden are usually made from one and one-half to three feet wide.



Forms and method of building one-course sidewalk.

Usually 2 x 4's are used for side forms, these being held in place by stakes driven along the outside. The top edges of the 2 x 4s are so placed that they serve as guides in leveling off the concrete. It is considered good practice to build walks about two inches above the surrounding grade so that they will be well drained. In building a four-inch walk, therefore, the area that is to be concreted will have to be excavated to a depth of two inches plus the thickness of the fill. To make sure that water will drain off, the walk should be sloped toward one side. A pitch of from ¼ to ½ inch is satisfactory for a walk three feet wide.

Walks are best built in one-course construction, which means that the full thickness of the concrete is placed at one time, using the same mixture throughout. For convenience in building and to provide for expansion and contraction joints, walks should be divided at four to six-foot intervals, with partition strips placed at right angles to the side forms. Every other section is then concreted. After these have hardened enough to be self-sustaining, the cross strips are removed and the remaining slabs placed.

Another method which has some advantages, in that it permits the walk to be built continuously, is to place strips of tarred felt against the division or header boards. When the header boards are removed, these strips, which extend entirely across the walk and for its full depth, remain permanently in position providing a definite joint between sections. In building walks by this method, concrete is placed on both sides of the header boards before it is lifted out. Then the pressure of concrete from both sides holds the tarred felt vertically, as it should be.

The proper mixture of concrete to be used for making sidewalks will be found in the preceding table. The concrete mixture, when of the right plasticity, is easily leveled off by a strikeboard resting on the edges of the 2 by 4 forms. This strikeboard is passed across the forms in a saw-like motion, thus leveling the concrete, filling the hollows and at the same time assisting to compact the concrete. The walk is finished with a wood float to provide an even gritty surface, and is done several hours after concrete is placed. At this time it will have become quite stiff, but still workable. To assist the concrete in curing properly, a covering of moist sand or earth, about two inches thick, is put on the concrete as soon as it has become sufficiently hard to resist marring, and is kept moist for about ten days. At the end of this time the covering may be removed and walk put into use.

PERMANENT STEPS

Job Specification

To construct a flight of concrete steps.

Materials and Equipment

Cement, water, sand, pebbles, oil, mixing board, measuring box; shovel, trowel, float, edger, 2″ x 6″ form board and braces.

Reasons for the Job

How often we see an otherwise attractive home with the wooden porch and the outside flight of wooden steps badly worn, decayed, or sagging away from the structure. Such steps and floors are a constant source of danger as well as being a continuous bother and expense to the homeowner. It is just as economical to have attractive permanent concrete porches and steps as it is to provide other worthwhile improvements around the home.

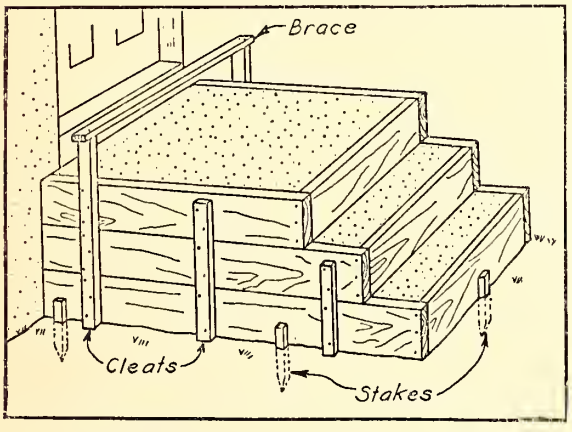
Concrete porches and steps are safe, non-slippery in wet weather, and last indefinitely. They are easy to keep clean and will not rot, burn, or require maintenance expense.

Procedure

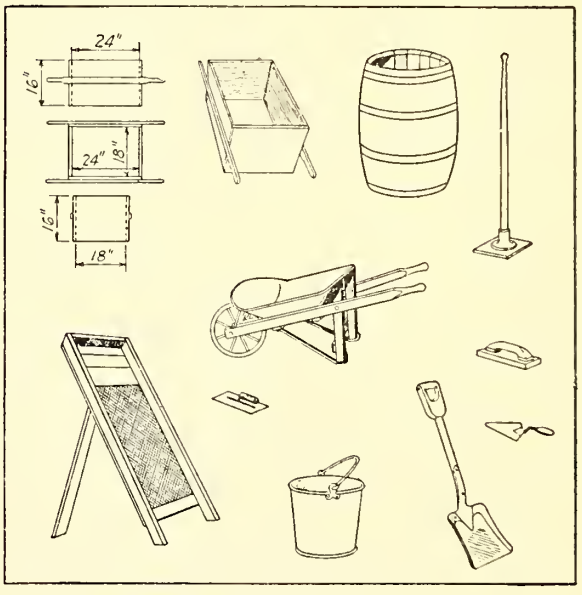
Forms for building concrete steps are shown on this page. For a comfortable flight of steps, the vertical distance from one step to the next should not exceed 7½ inches, the width of tread should be about 10 inches. Either one-inch or two-inch lumber may be used for forms. The standard mixture for this type of construction is given in the table on page 45.

The concrete should be of rather stiff consistency and should contain sufficient mortar to produce a smooth even surface. Finishing with a wood float produces a smooth yet gritty surface. Cure as recommended.

When steps are built with sidewalls, the latter are placed first and allowed to harden.



Simple forms for building concrete steps.



Tools commonly used in farm concrete work.

1. Compare the life of wooden steps to concrete steps. .....

.....

2. When do you think it would pay to construct concrete steps? .....

.....

.....

3. Why are slick sidewalks dangerous?

.....

.....

4. Explain how a concrete sidewalk should be finished. .....

.....

.....

FLAG STONES

Job Specification

To make flag stones.

Materials and Equipment

Cement, water, sand, pebbles, oil, mixing board, measuring box, shovel, trowel, float, and edger.

Procedure

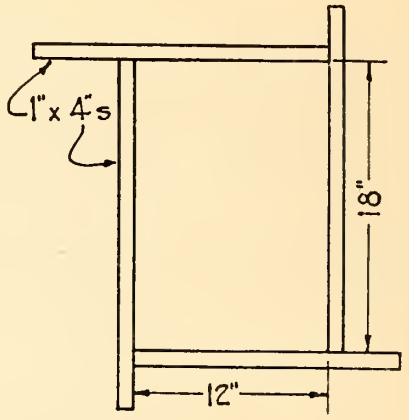
Make the type of forms that you like best and proceed as in building a side walk. The flag stones may be made from two to four inches thick.

Flagstone Walks

In the garden it is often desirable to construct a flagstone type or a stepping-stone type of walk. Either treatment adds greatly to the charm of the surroundings and may be easily executed in concrete.

Simple forms for making flagstones of concrete are shown on this page. The various sizes of stone may be placed in any one of a number of interesting designs. The forms will have to be used several times and they should be assembled so that they may be taken apart easily. Oil them well before concreting. The same mixture of concrete and method of placing and curing as described for the ordinary sidewalk may be followed. In making stepping stones of concrete, irregular shaped holes may be dug in the ground in the position in which the stones are to lie.

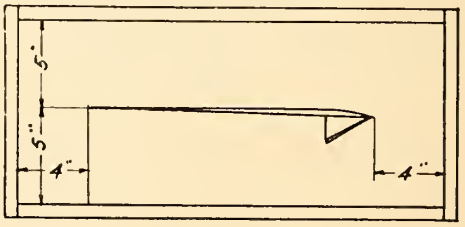
The concrete is then placed into these forms and smoothed off and allowed to cure as recommended. Mineral pigments are often introduced into the mixture to produce stepping stones or flagstones of different shades.



Form For Concrete Flag Stone

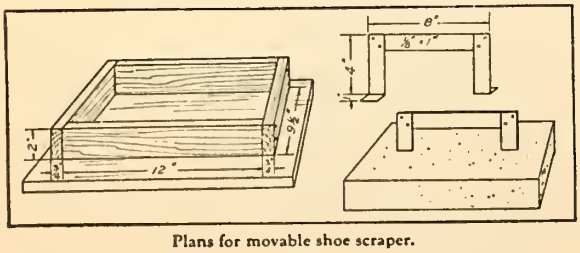
A MOVABLE SHOE SCRAPER

A handily placed concrete shoe scraper is a home improvement which will be welcomed by every housewife. Assemble the forms and rivet the iron straps together as shown on this page. Using the concrete mixture recommended (1 part of cement, 2 parts of sand and 3 parts of gravel), fill the forms holding the metal scraper in the center of the form about ¾ of an inch above the pallet. Tamp well and smooth off the surface, using an edger to round off the outside edges. After the scraper has hardened for about 24 hours, carefully dismantle the forms and remove the block. Allow it to cure for at least 10 days before using. When a sidewalk is to be built at the house entrance a shoe scraper may be set in place.

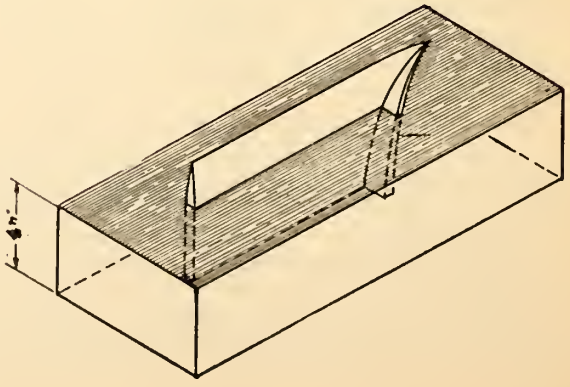


· TOP · VIEW ·

· ISOMETRIC · VIEW ·



Plans for movable shoe scraper.



CONCRETE SLAB

Job Specification

To construct a concrete slab to be used as a stepping stone.

Materials and Equipment

Two shovels, trowel, edger, bucket, 1 cu. ft. measure, form 24″ x 18″ x 3″, float, cement, sand, gravel, and mixing board.

References

Concrete Around the Home—Portland Cement Association.

Farm Mechanics Text and Handbook, Chap. XIX—Cook, Scranton & McColly.

Procedure

Take the cubic foot measure and secure the amount of sand, gravel, and cement that will be needed for the job, using a mixture of 1 part of cement, 2 parts of sand, and 3 parts of gravel:

1. Mix these materials, thoroughly, while dry.
2. Add only enough water to make a good plastic mix.
3. Place the concrete into the form.
4. Spade the sides well with a trowel, to provide smooth edges.
5. Level off the concrete, using the straight edge, sliding it back and forth across the top of the forms and moving it forward at the same time.
6. Finish with a steel or wooden float and use the edging tool around the edges.
7. The slab should be sprinkled with water occasionally for several days or covered with dirt or sacks.
8. After two days the forms may be carefully removed.

1. What do we mean by curing concrete?.....

.....

.....

2. What is the purpose of moistening concrete when curing?.....

.....

CURING CONCRETE

Concrete hardens because of chemical reactions between Portland Cement and water. The process continues indefinitely, so long as the temperatures are favorable and moisture is present to complete the hydration. The quality of concrete, therefore, is dependent on its age and the conditions under which it cures.

Effect of Moisture

Figure 1 shows that moist curing during the early hardening period greatly increases strength. In these tests all specimens were tested at four months, but they were damp cured for various periods and then allowed to cure in dry air until tested. It will be seen that an increase of 72 per cent was obtained by keeping the concrete damp the first ten days instead of letting it dry out. Keeping the concrete damp three weeks increased the strength 124 per cent and for four months 207 per cent over the strength of concrete cured the entire period in a dry atmosphere.

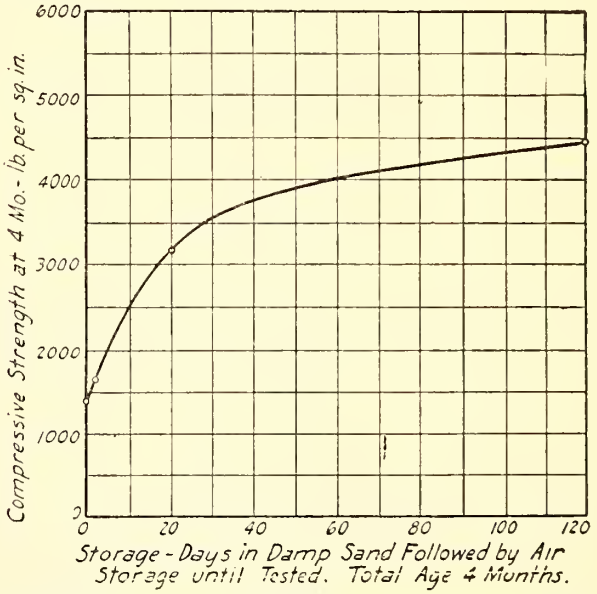


Fig. 1

Typical relation between curing condition and the compressive strength of concrete. Specimens were cured in damp sand for the period indicated in horizontal scale, followed by air storage until time of test.

Effect of Age

The strength of concrete, under favorable curing conditions, increases in strength with age.

3. Give two methods to use in curing a concrete sidewalk .....

.....

4. What effect does heat have on curing concrete? .....

.....

SILT TEST FOR SAND

Job Specification

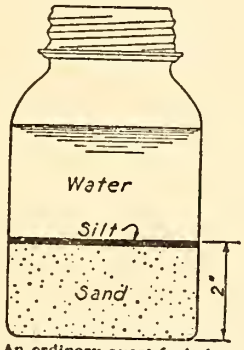
To test sand and aggregate for use in concrete work.

Materials and Equipment

Four samples of sand and four samples of aggregate.

Procedure

Examine the samples of sand and aggregate for visible foreign matter. Fill the jars one-half full of sand, finish filling with water, shake well and allow to stand for 24 hours.



An ordinary quart fruit jar may be used to make the silt test for sands.

The silt will settle on top of the sand and if there is more than one-quarter of inch silt the material should not be used for concrete work, unless it is thoroughly washed.

References

Farm Concrete—Ekblaw.
Concrete Practice—Hool and Pulver.
Bulletins from Portland Cement Company.

Sand

	Amount of Silt	Nature of Aggregates and Sand
Sample No. 1		
Sample No. 2		
Sample No. 3		
Sample No. 4		

Aggregates

Sample No. 1	
Sample No. 2	
Sample No. 3	
Sample No. 4	

Place the samples from best to poorest for farm concrete work.

Sand

1st	2nd	3rd	4th

Aggregates

1st	2nd	3rd	4th

TESTING BANK RUN GRAVEL

Job Specification

To determine the proportions of bank run gravel.

Materials and Equipment

Measuring box, ¼-inch screen, and shovel.

Procedure

Determine the proportions of sand and pebbles in the samples of bank run gravel.

Measure out one cubic foot of the sample of bank run gravel, being careful to get a representative sample.

Screen the sample through a ¼-inch screen. That which passes through the screen is considered sand, while the balance is pebbles.

By use of the measuring box, determine the part of a cubic foot there is of sand and of pebbles.

Report

Sample	Sand cu. ft.	Pebbles cu. ft.	Proportion
a			1 sand:.pebbles
b			1 sand:.pebbles
c			1 sand:.pebbles

How many cubic feet of pebbles would have to be added to 2 cubic feet of Sample "a" to make a 2-4 mixture?.....cubic feet. How many to 2 cubic feet of Sample "b" to make a 3-6 mixture?

.....cubic feet.

FIGURING BILLS OF MATERIAL

Lumber is usually purchased by the board foot. One board foot is 1″ thick and 12″ square, or 144 cubic inches. To find the board feet in any piece of lumber multiply the thickness in inches, by the width in inches, by the length in feet and divide by 12.

If the length is also given in inches, then divide by 144.

$$\text{Bd. Ft.} = \frac{\left\{\begin{matrix}\text{Thickness}\\ \text{in}\\ \text{inches}\end{matrix}\right\} \times \left\{\begin{matrix}\text{Width}\\ \text{in}\\ \text{inches}\end{matrix}\right\} \times \text{Length in ft.}}{12}$$

Example

$$\text{One piece of } 2'' \times 4'' \times 18' \quad \frac{6}{\frac{12}{3}} = 12 \text{ Bd. ft.}$$

$$\text{Bd. Ft.} = \frac{\left\{\begin{matrix}\text{Thickness}\\ \text{in}\\ \text{inches}\end{matrix}\right\} \times \left\{\begin{matrix}\text{Width}\\ \text{in}\\ \text{inches}\end{matrix}\right\} \times \left\{\begin{matrix}\text{Length}\\ \text{in}\\ \text{inches}\end{matrix}\right\}}{144}$$

Example

$$\text{One piece } 1'' \times 12'' \times 18'' \quad \frac{}{\frac{144}{12}} = 1\tfrac{1}{2} \text{ Bd. ft.}$$

Panel board or ply board is usually sold by the square foot, the thickness being designated when purchased.

Mold, parting stop, blind stop, and other light lumber is usually sold by the linear foot.

Upon actual measurements it will be found that the thickness and width of lumber varies, but does not change its unit of board foot measure. A ¾″ board is sold as 1″ for board foot measure. A standard 12″ board usually measures 11-5/8″ while a piece of 2″ x 4″ will measure 1-5/8″ x 3-5/8″. The length is always slightly more than specified.

The full length is always assured. This is allowed in order that the ends may be squared.

When figuring large lumber bills and not being convenient to figure the exact number of pieces it is necessary to make an allowance for the loss. For example: a room 10′ x 12′ would measure 120 square feet, but would require more than 120 board feet of flooring.

Make the Following Allowances

1″ x 4″ flooring add ¼ to total sq. ft.

1″ x 8″ shiplap add 1/6 to total sq. ft.

1″ x 6″ siding add 1/6 to total sq. ft.

Lumber is generally surfaced in order that it may be more easily finished. That is why the thickness and width is reduced and is sold as S2S, and S4S, the latter meaning surfaced on four sides.

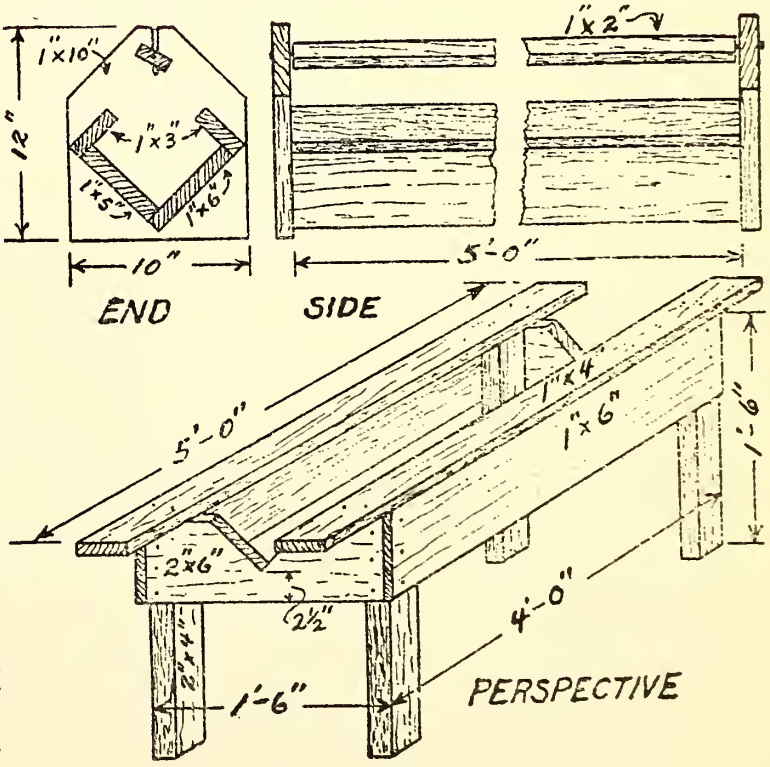
When figuring bills of material it is always necessary to make an allowance for waste. For instance, if a job should require one piece of 1″ x 10″ x 11′ it would be necessary to purchase a 12′ board.

Correct Form for Figuring a Bill of Material

On small jobs it is best to make a cutting bill of the job first and then convert it into lumber yard measure.

Example

Figuring a Bill of Material for a Poultry feeder and stand.



Cutting Bill

Stand

No. Pcs.	Material Used
4	2″ x 4″ x 18″ —Legs
2	2″ x 6″ x 16½″—Ends
2	1″ x 6″ x 48″ —Sides
2	1″ x 4″ x 60″ —Top

Feeder

No. Pcs.	Material Used
2	1″ x 10″ x 12″ —Ends
2	1″ x 6″ x 60″ —Trough
2	1″ x 3″ x 60″ —Trough
1	1″ x 2″ x 59½″—Reel

Convert to Lumberyard Measure

For this job it will be necessary to order:

24″	of 1″ x 12″
36″	of 2″ x 6″
216″	of 1″ x 6″
120″	of 1″ x 4″
120″	of 1″ x 3″
59½″	of 1″ x 2″
72″	of 2″ x 4″

No. Pieces	Dimensions	Kind of Material	Bd. Ft.	Grade	Price	Cost
1	1″x 12″x 2′	Y. Pine	2	1	5c	.10
1	2″x 6″x 3′	"	3	2	4c	.12
1	1″x 6″x 18′	"	9	1	5c	.45
1	1″x 4″x 10′	"	3⅓	1	5c	.15
1	1″x 3″x 10′	"	2½	1	5c	.12
1	1″x 2″x 5′	"	1	1	5c	.05
1	2″x 4″x 6′	"	4	2	4c	.08
		Total	25			$1.07
	1 pint of paint					
	2 lbs. 8 casing nails					
	1 pint of paint					.40
	2 lbs. 8 casing nails					.10
		Total				$1.57

Problem

Find the size of your class room and figure the number of board feet needed to cover, using 1″x4″ flooring.

Size of Class Room.....

No. Square Feet.....

No. Board Ft. Lumber Required.....

MEASURING LUMBER IN THE LOG

For practical purposes the number of board feet of lumber that may be obtained from a log of certain size is given with fair accuracy by the following rule known as Doyles Rule.

From the number of inches in the smallest diameter of the log subtract 4, multiply the remainder by half itself, multiply this result by the number of feet in the length of the log, and divide by 8.

For example, the number of board feet in a log 16′ long and having a smallest diameter of 18″ is approximately

$$\frac{18-4 \times 7 \times 16}{8} = \frac{14 \times 7 \times 16}{8} = 196$$

Problems

Determine approximately the number of board feet of lumber in logs of the following lengths and smallest diameter.....

1. Length 24′, diameter 12″.....
2. Length 20′, diameter 14″.....
3. Length 20′, diameter 20″.....
4. Length 28′, diameter 24″.....
5. Length 16′, diameter 18″.....
6. Make drawing of the cross-section of a log.
7. How is the age of a tree determined?

.....

.....

Questions on Lumber

1. Name the trees that grow in your county.....

2. How are the ages of trees determined?.....

3. List all the kinds of wood used on your farm.

4. What is a board foot?.....

5. The largest tree in the world is "General Sherman," a redwood in California containing 600,120 board feet in the trunk and is over 3000 years old. About how many 5 room houses could be built from this tree?.....

6. Name some woods that are used in furniture making.....

7. What causes a tree to die when the bark is cut around? .....

8. What are the standard lengths in which lumber is usually purchased at the lumber yard?

9. What lumber is sold by the board foot?.....

   By the square foot?.....

   By the linear foot?.....

10. What are the grades and prices of lumber at your local lumber yard?.....

11. What causes lumber to warp?.....

12. List the wood working projects that need to be done at your home.....

13. What kind of lumber should be used for the following:

PROJECT	KIND OF LUMBER
Farm gate	
Hog trough	
Single tree	

TOOL CABINET

Job Specification

To figure a bill of material for a shop tool cabinet and construct same.

NOTE: The sides and ends of this cabinet should be made from a piece of 1″ x 6″. After the back and front has been nailed on, the cabinet should be gauged to 2¾″ and the doors ripped off and cut into two parts.

Materials. **Cutting Bill**

No. Pieces	Dimensions	Use

Lumber Yard Bill

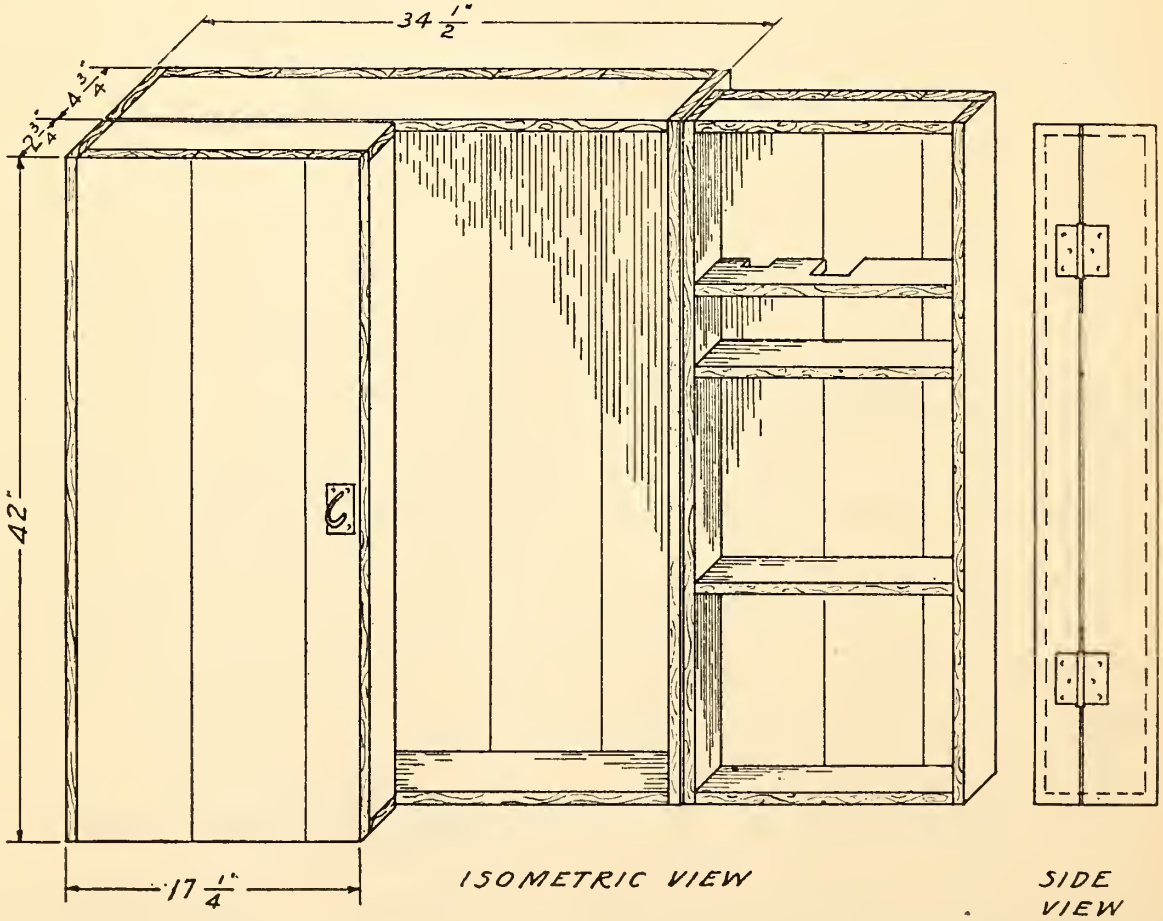
No. Pcs.	Dimensions	Kind of Material	Bd. Ft.	Grade	Price	Cost

Total

Hardware.....

Paint.....

Total Cost.....



ISOMETRIC VIEW

SIDE VIEW

TOP VIEW

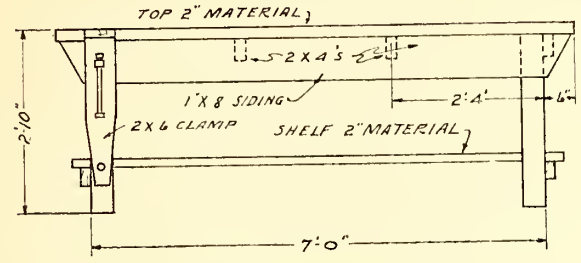
FARM SHOP WORK BENCH

Job Specification

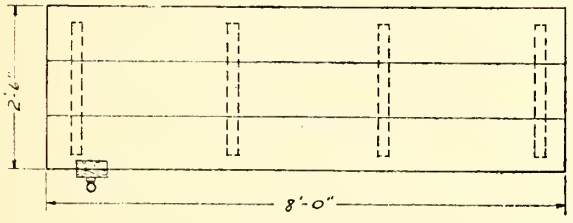
To figure a bill of material for a farm shop work bench and estimate the cost.

Procedure

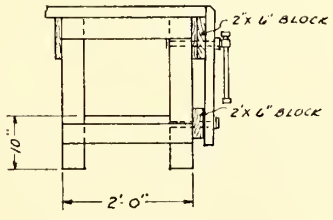
Make a list of the pieces of material and reduce to lumber yard measure.



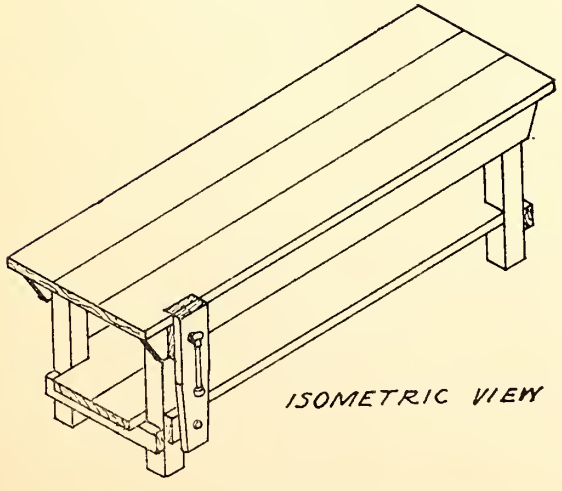
SIDE VIEW



TOP VIEW



END VIEW



Cutting Bill

No. Pieces	Dimensions	Use

Lumber Yard Bill

No. Pcs.	Dimensions	Kind of Material	Bd. Ft.	Grade	Price	Cost

Farm shop benches can be made at home at a much lower cost than purchased ready made from a factory. Very few manufactured benches are suitable for farm shop use. In case it becomes necessary to hire a carpenter to construct the bench, it will be found more satisfactory than to have it mill made.

Note: Drawers may be placed in the bench to hold tools or supplies. The bench should be given two coats of paint.

Questions

1. What size nails should be used in the assembling of the bench?.....

2. List in order the steps to take in assembling the bench.....
   (1).....
   (2).....
   (3).....
   (4).....
   (5).....
   (6).....
   (7).....
   (8).....
   (9).....

A NAIL AND HAMMER BOX

Job Specification

To figure a bill of material and construct a nail and hammer box.

Purpose

A nail and hammer box is a handy thing to have around the house. It is also convenient to carry staples in when repairing fence.

The box can also be made from orange or apple crates, using the thin material for the bottom and sides and the thick material for the ends and partitions. An old broom handle can be put in for the box handle.

Materials

Figure Bill of Material for the box.

Cutting Bill

No. Pieces	Dimensions	Use

Lumber Yard Measure

No. Pieces	Dimensions	Bd. Ft.	Grade	Price

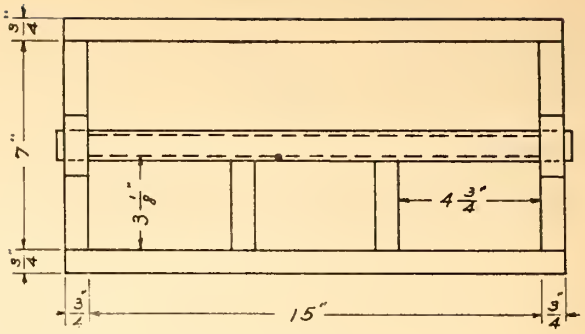
Procedure

1. Cut stock according to the dimensions of the drawings.
2. Put in handle.
3. Nail on sides.
4. Put in partition.
5. Nail on bottom.
6. Finish the box by giving it two coats of paint.

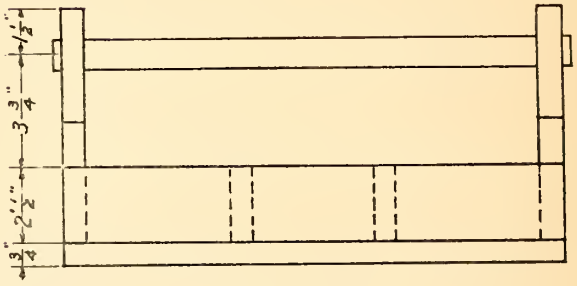
Questions

1. What kind and size of nails should be used on the box?.....
2. List tools used in the construction of this job.

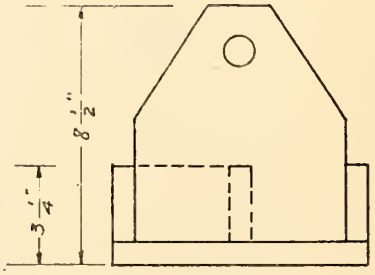
.....



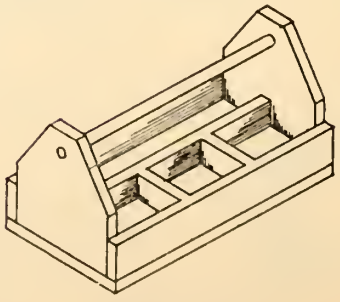
Top View



Side View



End View



Isometric View

TOOL CARRIER

Job Specification

To construct a tool carrier.

Materials and Equipment

5/16 Ply Board.

Pieces	Dimensions	Use
1	½″ x 10″ x 60″	Ends and bottom
5	½″ x 6″ x 34″	Sides and partitions
1	34″ Broom handle.	Handle

Hardware: 4 dozen 4D casing nails.
½ pint paint.

Note:

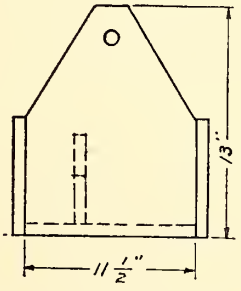
As this carrier is made of ½″ material of short lengths, crating material may be secured from stores and used instead of ply board.

Procedure

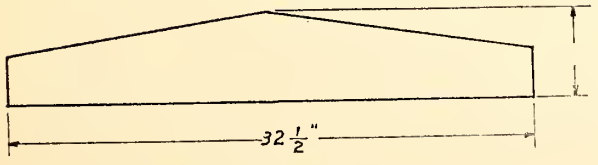
1. Cut stock to dimensions as called for in plans.
2. All rough edges should be smoothed with a plane.
3. Assemble by nailing ends on bottom, then nail on sides.
4. Put in partitions for saws.
5. Bore a hole in ends the size of the handle, take care not to split the material when the bit is almost through.
6. Smooth up with sand paper and apply two coats of paint.

References

Agricultural Mechanics—Smith.



END VIEW



PARTITION FOR SAWS

HARNESS STITCHING CLAMP

Job Specification

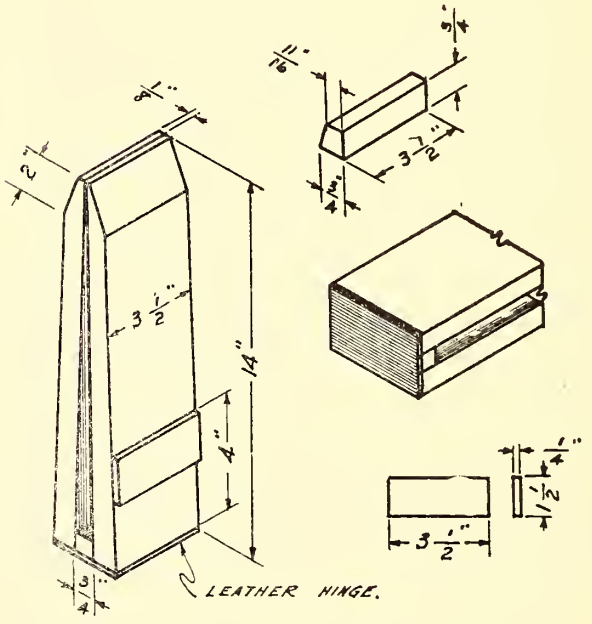
To make a harness stitching clamp.

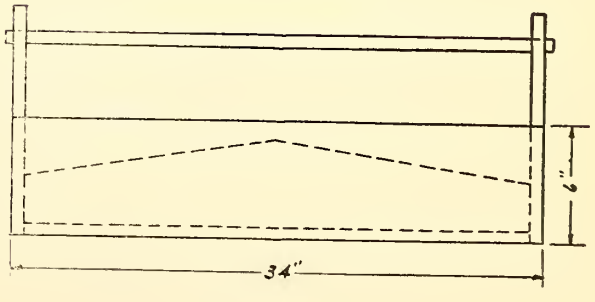
Materials and Equipment

One piece of board 1″ x 4″ x 28″ long. A small piece of leather 4″ x 3″ for hinge.

Procedure

Follow the drawing below and make a harness stitching clamp. This clamp may be placed in the work bench vise and held securely for use.





SIDE VIEW

SAW HORSE

Job Specification

To make a saw horse.

Materials and Equipment

Pieces	Dimensions
1	2″ x 4″ x 3′
1	1″ x 4″ x 10′

Tools

Framing square, T bevel, saw, hammer, 1″ wood chisel.

Procedure

1. Using 3½ and 12 on the square mark along the edge of the piece of 1″ x 4″ material for the leg.

2. Using 3½″ and 24″ mark the legs as shown in Figure 4. The top cut is the same as the bottom.

3. All four legs are exactly alike.

4. Using 3½″ and 24″ on the square, mark the four side lines on the top of the horse 3½ inches from the end, as shown in Figure 3. Take one of the legs as a gauge and make the four inside marks on the sides.

5. Gauge ¾″ on the top and ¼″ on bottom, as shown in Figure 5. All four places where the legs are to fit should be gauged. Saw down to the gauged marks on top and bottom. The side lines should not be cut out as the place would be too large for the legs.

6. Set the T bevel on 1-1/8″ and 4″, mark and work out the places with a chisel for the legs, as shown in Figure 5. The legs should fit tightly.

7. Nail legs on top of the saw horse with 6D nails. The top of the legs should be flush with the top of horse.

8. Set T bevel on 5/8″ and 4″ and work down one edge of the end brace to fit T bevel. The end pieces should be 8″ or 10″ long. (See Figure 6.)

9. Spread legs to 17½″ and nail on end braces as shown in Fig. 2.

10. Saw end braces off flush with legs.

11. Finish the saw horse with two coats of paint.

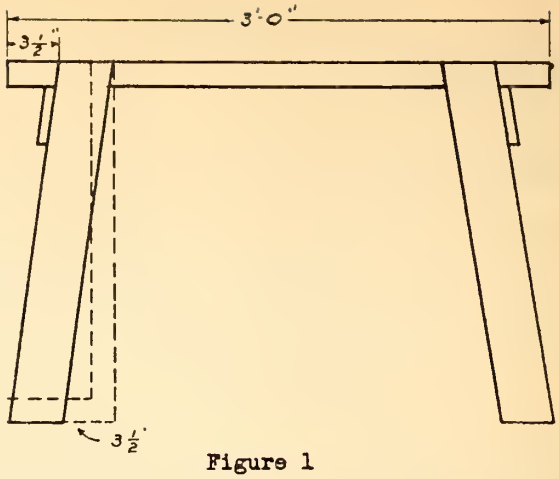


Figure 1

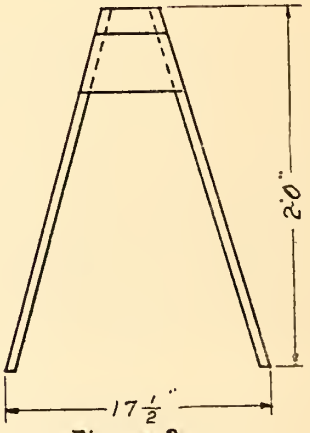


Figure 2

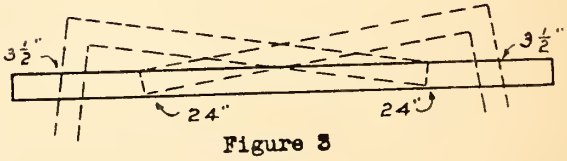


Figure 3

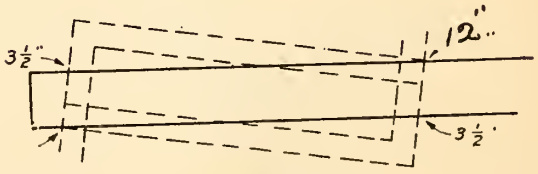


Figure 4

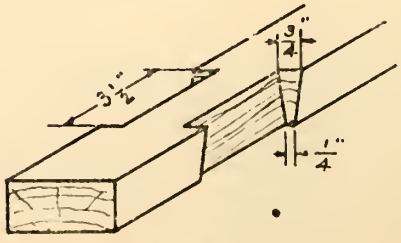


Figure 5

Figure 6

BUDDING KNIFE

Job Specification

To make a budding knife.

Materials and Equipment

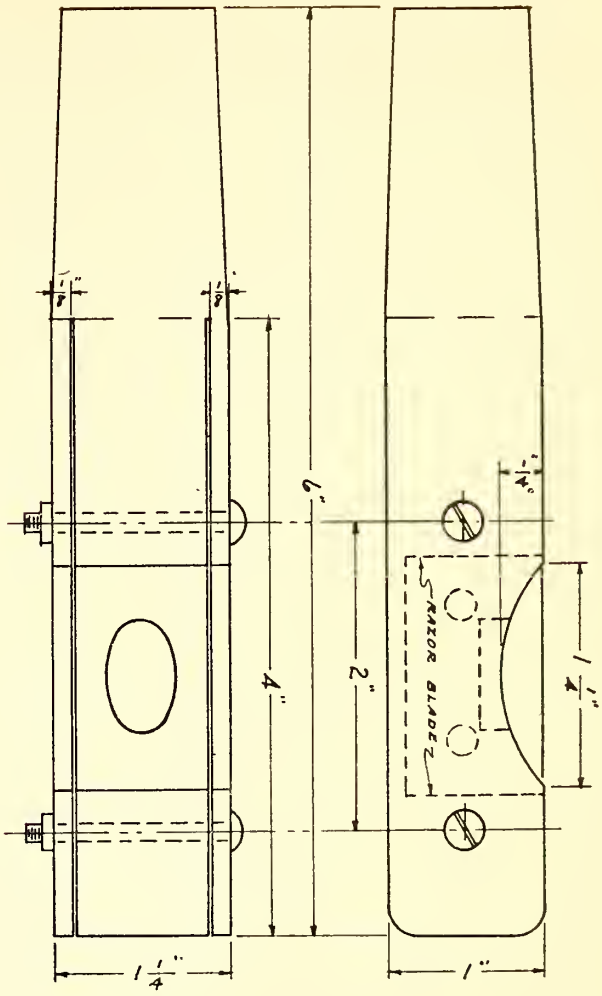
One piece of hardwood 1″ x 1¼″ x 6″, brace and 3/16″ bit, 2 stove bolts 1½″. 2 razor blades, saw, and a wood rasp.

Procedure

Cut the stock and work it to size as mentioned in the material bill. Be sure that the stock is try and square. Gauge the piece of material 1/8″ on the front side and then gauge it the same on the back. This will aid in sawing.

Use a fine tooth saw or a band saw and cut down a 4-inch space for the razor blades. The saw should be kept on the inside of the marks and great care should be taken to keep these two lines parallel. If the lines are not parallel, it will mean that you may have trouble fitting the bud on the tree. Bore the holes in the stock with a 3/16″ bit, then place the material in a vise and with a wood rasp work out space as shown in the drawing. Be very careful that you do not split any of the material off on the opposite side when filing. With a wood chisel work out a space in the center about ¼″ deep. This will keep from injuring the bud when you are cutting it.

The knife should be sanded and may be stained or varnished.



BOOK RACK

Job Specification

To construct a book rack.

Materials and Equipment

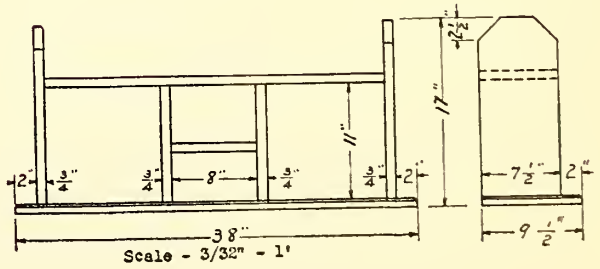
1 piece of 1″ x 8″ x 98″
1 piece of 1″ x 10″ x 38″

Procedure

Cut stock to dimensions as shown in the drawing. All the stock can be cut from one piece of material except the bottom. B or better material should be used.

This job may be assembled either with screws or nails. If nails are used they should be set and the holes puttied.

The job may be finished by staining, varnishing, shellacing, or burning with a blow torch.



Note:

Students are encouraged to design their own book racks. Working drawings should be made, bill of material figured and work checked by the instructor before work is started.

EVENERS

Job Specification

To make eveners.

Three Horse Evener

Material: 1 piece of ash, oak or hickory 1¾" x 6" x 49". Two carriage bolts ¼" x 5½", or rivets may be used.

1. Reduce stock to size given in drawing.
2. Chamfer edges.
3. Bore holes according to dimension given in drawings.
4. Treat evener with linseed oil or paint.

Two Horse Evener

Material: 1 piece of ash, oak or hickory 1¾" x 6" x 38".

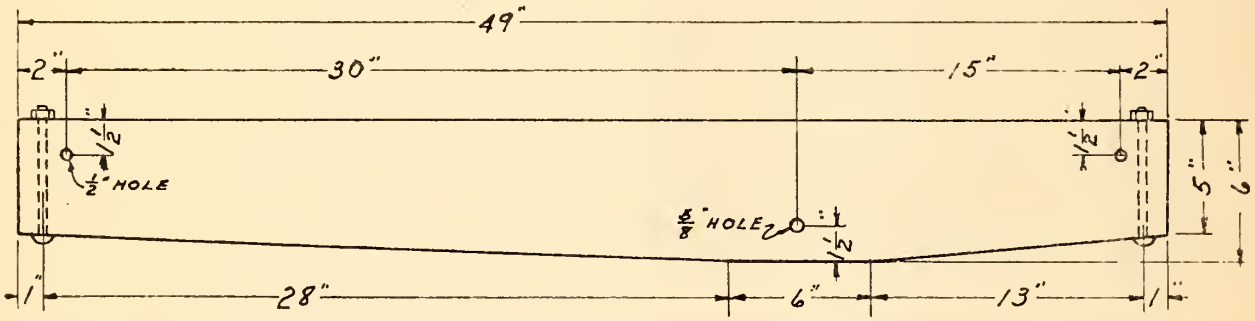
1. Use the same procedure as for the construction of the three horse evener.

Single Tree

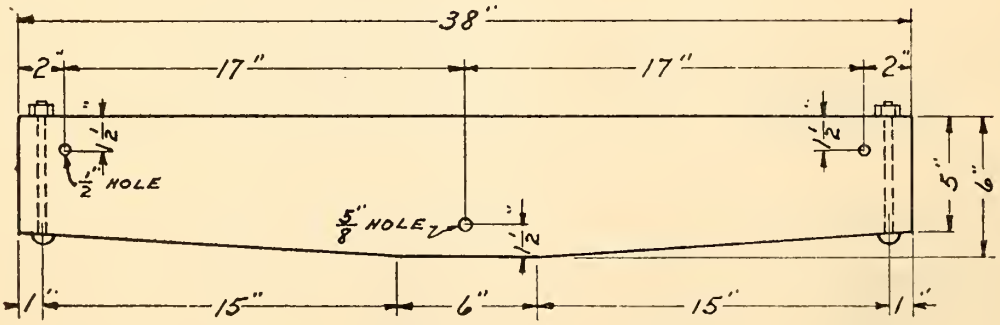
Material: 1 piece of ash, oak or hickory 1¾" x 3" x 30".

1. Work stock to dimensions as given in drawing.
2. Chamfer edges.
3. Treat with linseed oil or paint.

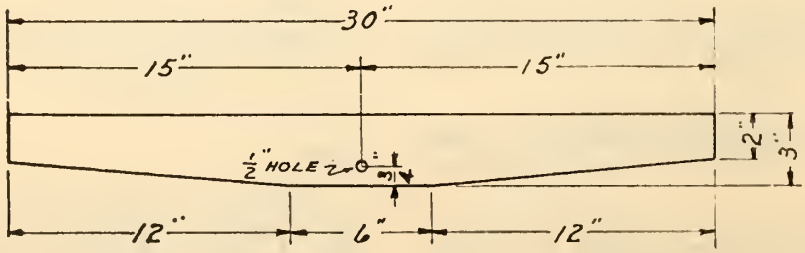
What is the difference in cost of a home made evener and one purchased from the store?



A THREE HORSE EVENER



STANDARD TWO-HORSE EVENER

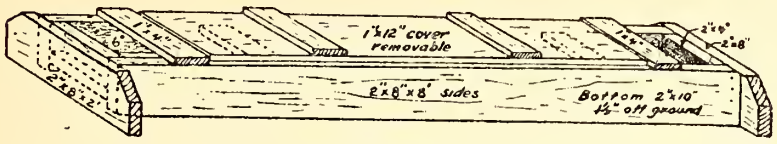


SINGLE TREE.

HOG LOT EQUIPMENT

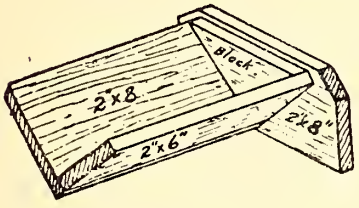
WATER TROUGH VERY IMPORTANT

One of the main features in providing a water supply for hogs is to get a sufficient quantity available so that they may get water whenever they want it. Numerous automatic water systems are used, but as a dependable and cheap arrangement the trough shown has proved very satisfactory. Enough trough capacity should be provided so that one filling per day will assure an abundant supply for the hogs. This trough is arranged so that a hog cannot wallow in it and the cover is arranged for easy cleaning of the trough.

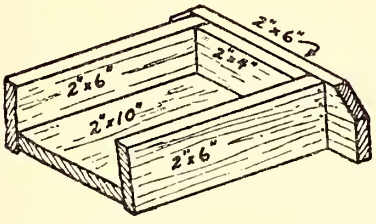


Water Trough

Feed or Slop Troughs



One end of "V" trough.



One end of flat bottom trough.

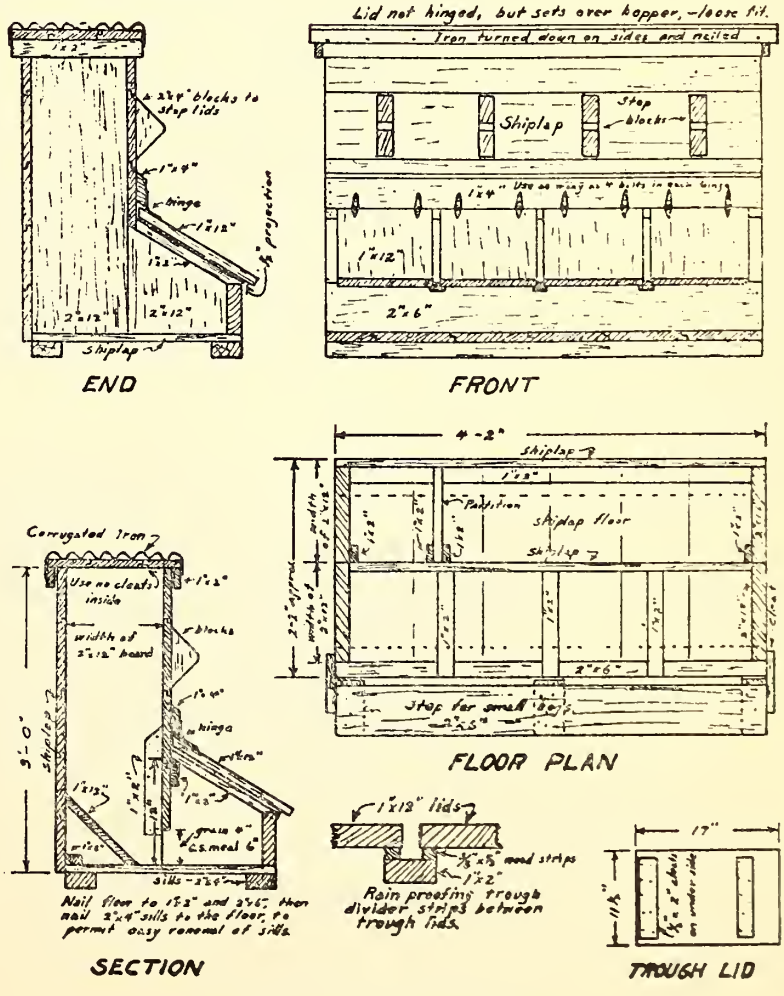
The sketch shows the construction of both flat bottomed and "V" shaped troughs. Note the double ends. Ends built like this do not knock off easily. They also make the trough leak proof. It is best to use separate troughs for water and feed.

Self feeders have been found satisfactory and economical for feeding hogs in large numbers. When hogs have access to different kinds of feeds necessary to produce pork they usually balance their rations satisfactorily. The feeds should be placed in separate feeders or in separate compartments of the same feeder.

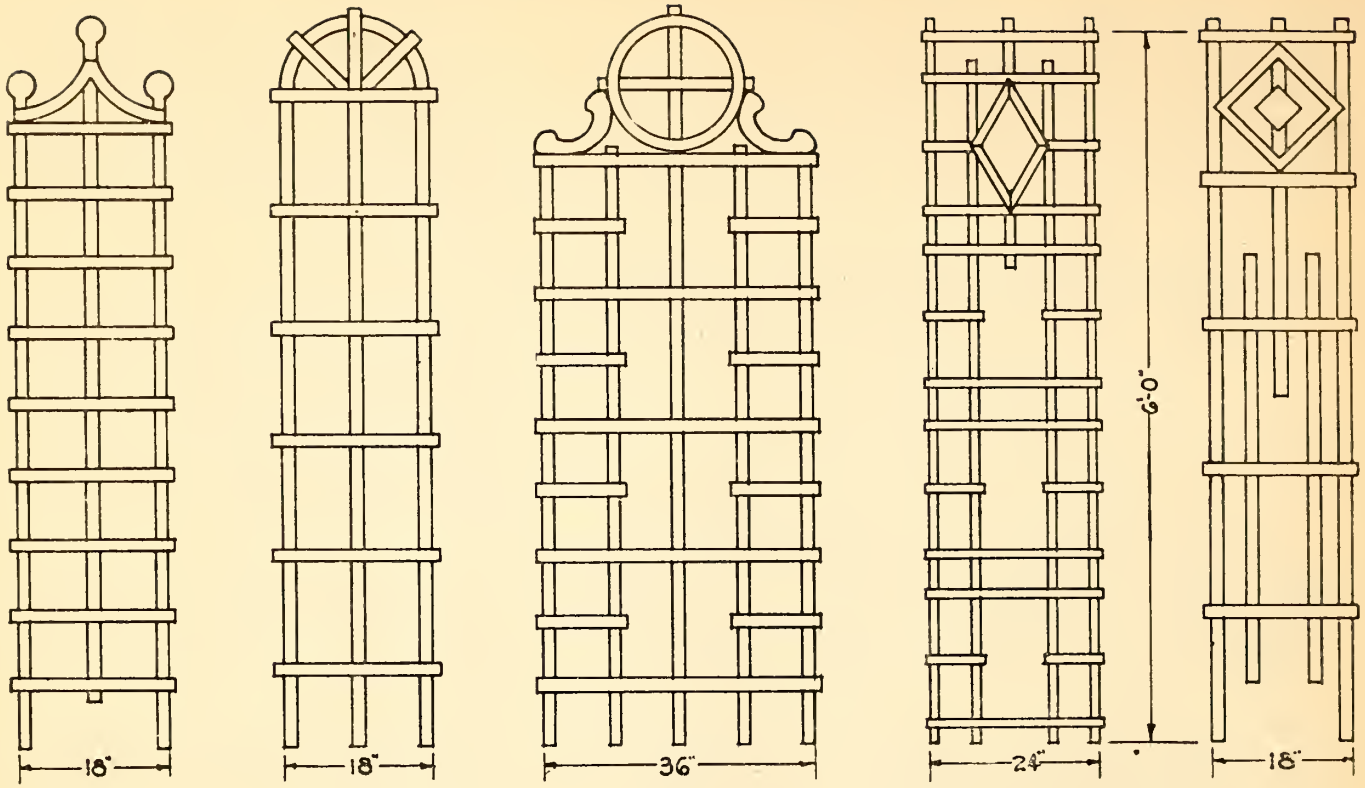
A good serviceable type of self feeder may be readily constructed by any farmer. Note that the drawing shows a flap to cover the trough that the pig eats from. This prevents rain from blowing into the feed and also keeps chickens from scratching out the feed. A pig will soon learn to lift this flap with his nose and eat, then when he withdraws his head, the flap drops down and covers the feed. It is important that the flaps be selected from a board that will not split easily. More than that, they will have to be re-inforced with strips of thin lumber running crossways. The hinges on the flaps must be fastened with small bolts. Hinges fastened with nails or screws will not stay in place very long when they get the rough treatment that hogs will give them on these feeders.

The self feeder may be made either shorter or longer than the one shown. In figuring the length of a feeder allow one linear foot of trough space for every two hogs. A feeder more than eight feet long would be too large for convenient handling. For a big herd of hogs use several feeders rather than one large one.

The feeder shown is designed for outdoor use. If the feeder is to be used under a shed, the flaps and cover may be left off in order to reduce the cost of the feeder.



Self Feeder for Outdoor Use



TRELLIS DESIGN

A well designed trellis covered with vines makes the home and surroundings more attractive. Above are a few designs that may be used.

The dimensions of the lumber are not specified as any number of sizes may be used. First measure the space to be filled by the trellis and then rip some strips and lay them out on the floor to determine the most suitable pattern and spacing.

Questions on Trellis Design

1. What kind of material should be used for the above trellis designs?

   .....

2. Would it be desirable to paint the trellis stock before assembling?

   .....Why?.....

   .....

   .....

3. Secure prices on lumber and figure the cost of any two designs above.

   BILL OF MATERIALS:.....

   .....

   .....

   COST:.....

   BILL OF MATERIALS:.....

   .....

   .....

   COST:.....

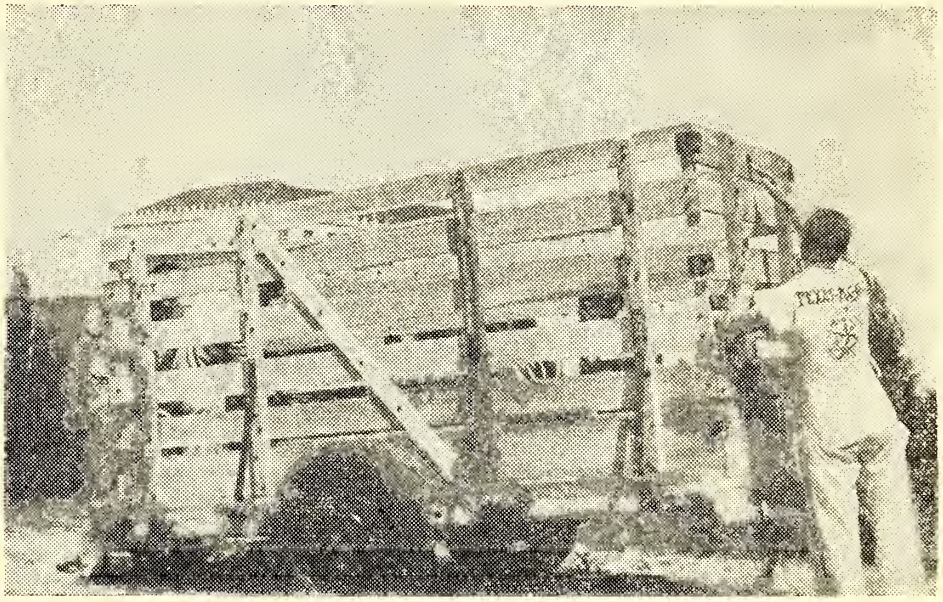
FARM TRAILERS

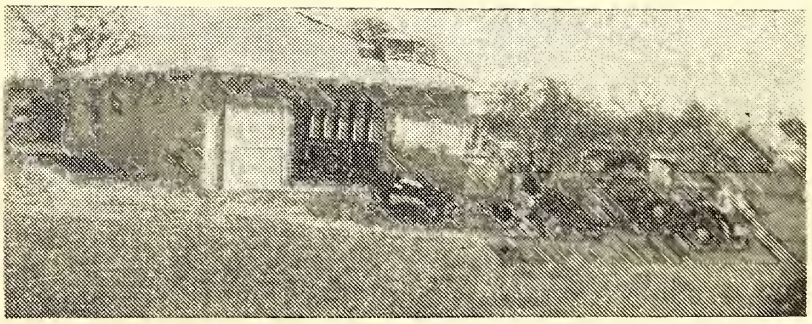
The construction of farm trailers has become a very popular shop job on the farm. Many farmers are designing and constructing trailers to meet their own particular needs. They may be built for either hauling livestock or farm products.

The running gears of automobiles are being used extensively in the construction of trailers. Either the front or the rear axles may be used.

Many vocational agriculture teachers have constructed trailers to be used in transporting their students on field trips, to fairs, and to judging contests.

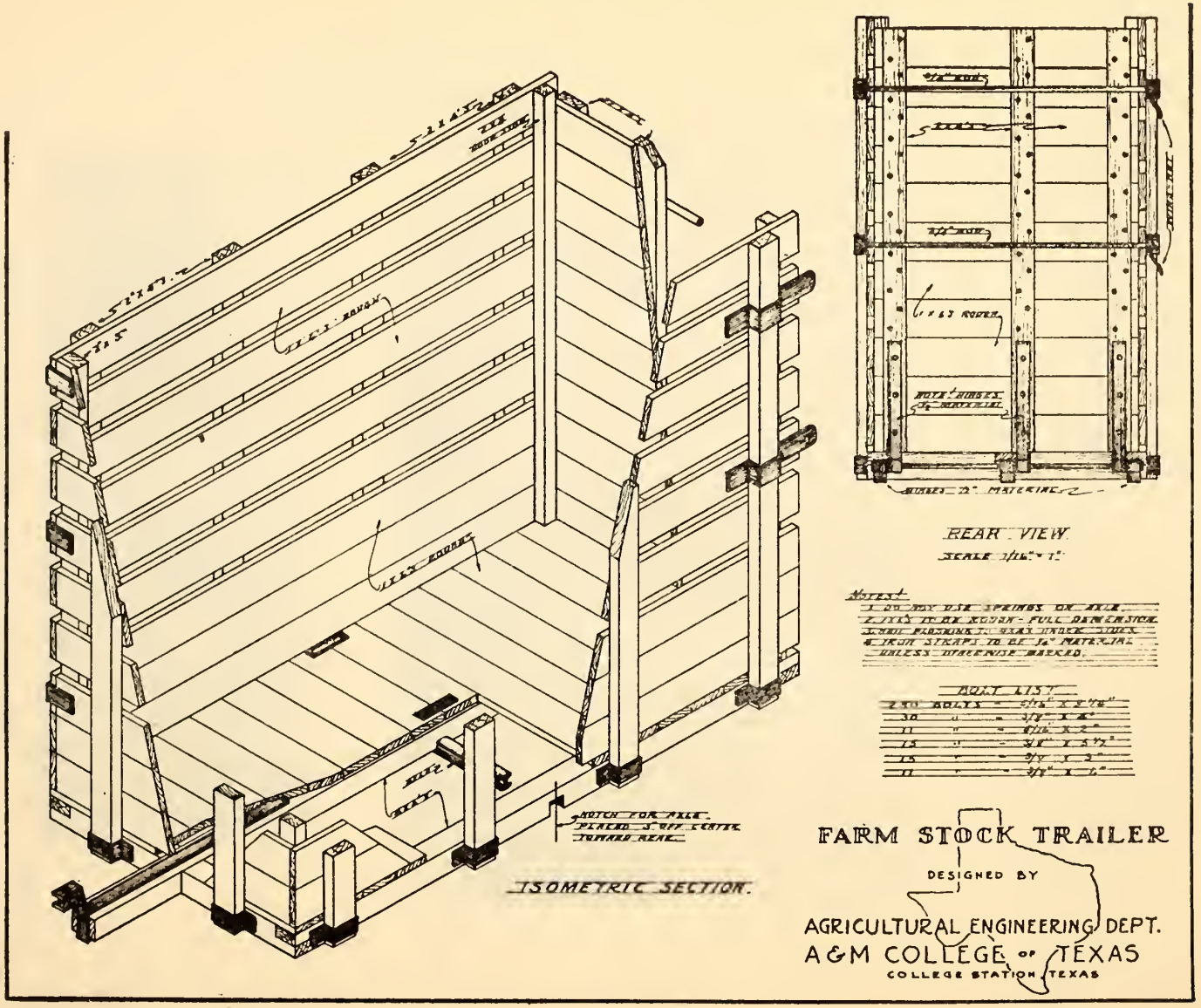
One of the most important parts for consideration in the construction of a trailer is the hitch. It should be built in such a way that it affords safety. It should be strong enough that there will be no danger of breaking and if a pin is used in the hitch it should be keyed, in order that it will not come out. There are many patented trailer hitches on the market that are highly satisfactory, and where these hitches can be purchased and installed, they save much time and trouble, and afford safety. Regardless of the type of hitch used on a student trailer, it should always have a safety chain attached.

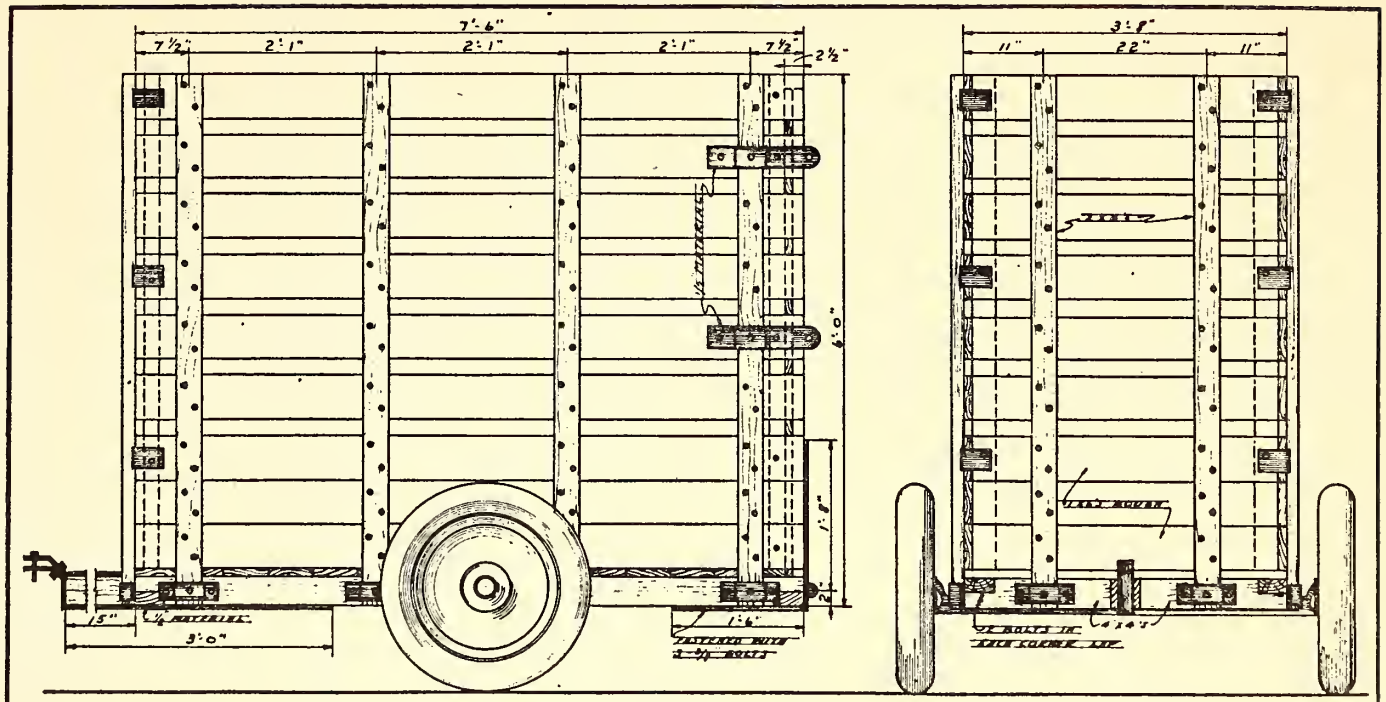




Picture of Trailer for Students and the Farm Shop, Built by Mr. Robert A. Manire, Madisonville, Texas.

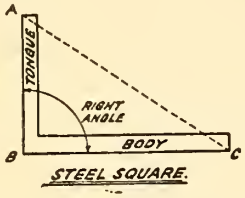
(Mr. Manire is now State Director of Vocational Agriculture for Texas.)


REAR VIEW
ISOMETRIC SECTION.
FARM STOCK TRAILER
DESIGNED BY
AGRICULTURAL ENGINEERING DEPT.
A&M COLLEGE OF TEXAS
COLLEGE STATION TEXAS


7'-6"
7½"
2'-1"
2'-1"
2'-1"
7½"
2½"
6'-0"
1'-8"
2"
15"
¼" BOLTERIES
3'-0"
1'-6"
FASTENER HOLE
2-⅝" BOLTS
3'-8"
11"
22"
11"
SIDE VIEW
SCALE: 1/16"=1'
FRONT VIEW
SCALE: 1/16"=1'
COMMON SIZES
WIDTH
LENGTH
LIGHT STOCK 44" 7'-0"
DAIRY " 9'-6"
MULES & HORSES 44" 8'-0"
LUMBER LIST

ROOF FRAMING

The steel square is one of the most useful tools that a carpenter can carry with him. It is so important in roof framing that it would be almost impossible to frame a roof without it. The square consists of two parts—the blade and the tongue. The standard length of the blade is 24″ long and 2″ wide. The tongue is either 16″ or 18″ long and 1½″ wide. It makes an angle of 90 degrees with the blade of the square.



Common Roof Types

Fig. 1.

Shed Roof

This is the simplest type of roof and has only a single slope (Fig. 1).

Fig. 2.

Gable Roof

This is the type of roof most commonly used. It has two slopes meeting at the center or ridge and forming a gable. This type of roof is perhaps the easiest to construct (Fig. 2).

Combination Roof

This type of roof is a combination of two shed roofs with different pitches.

Hip Roof

Fig. 3.

This roof consists of four sides sloping to the center of the building. The hip rafters rest on the corners of the building and meet the ridge into which the other rafters are framed (Fig. 3).

Fig. 4.

Fig. 5.

Roof Framing Terms and Definitions

Span—The span is the width of the building or the distance over the wall plates.

Run—The run is the shortest horizontal distance measured from a plumb line through the center of the ridge to the outer edge of the plate. On a gable roof it is one-half the width of the building.

Rise—The rise of a roof is the distance from the top of the ridge and of the rafter to the level of the foot. In figuring rafters the rise is considered as the vertical distance from the top of the wall plate to the upper end of the measuring line.

Rule to Find the Rise

To find the rise of a roof multiply the pitch by the span.

Example

A building is 24 feet wide and has a gable roof 1/3 pitch. What is the rise?

Rise equals 1/3 x 24 =8 feet.

The span, run, rise, pitch and measuring line are illustrated in Fig. 8.

Pitch—The pitch of a roof is the slant. It is measured by dividing the rise by two times the run.

Formula for Pitch:

P—pitch
r—rise
R—run

$$P = \frac{r}{2R}$$

Ridge—The ridge board is the horizontal member upon which the rafters rest at the top of the roof. It strengthens the roof and gives a straight top line. On small buildings the ridge board is often omitted. (See Fig. 5.)

Plate—The plate is the roof member on which the rafter rests. (See Fig. 8.)

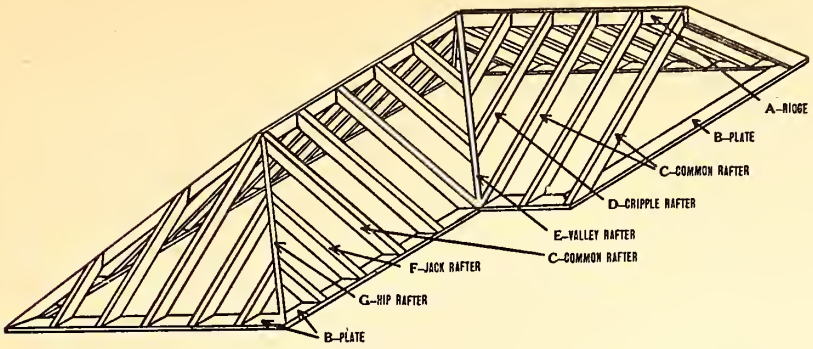


Fig. 6.

The illustration shows the frame of a roof, showing: A, ridge; B, plate; C, common rafters; D, cripple rafters; E, valley rafters; F, jack rafters; G, hip rafter.

ROOF FRAME

Common Rafters—The common rafter extends at a right angle from the plate to the ridge. (See Fig. 7.)

Cripple Rafter—The cripple rafter is one that meets the ridge and meets the valley rafter. (See Fig. 7.)

Valley Rafter—The valley rafter extends from the point of intersection of two roofs as shown in Fig. 7.

Jack Rafters are "discontinued" common rafters, or common rafters "cut off" by the intersection of a hip or valley before reaching the full length from plate to ridge.

Jack rafters lie in the same plane with common rafters. They usually are spaced the same and have the same pitch and therefore they also have the same length per foot run as common rafters have.

Jack rafters are usually spaced 16 inches or 24 inches on centers and as they rest against the hip or valley equally spaced the second jack must be twice as long as the first one, the third three times as long as the first and so on. (Fig. 6.)

Hip Rafter—The hip rafter extends from the corner of the building to the ridge. (See Fig. 7.)

Seat Cut—The seat cut is the notch that is cut out on the rafter to set on the plate.

Plumb Cut—A plumb cut is the cut that coincides with a plumb line when the rafter is in its position.

Level Cut—A level cut is the cut that coincides with a horizontal or level line when the rafter is in position.

Side Cut—Hip, valley and jack rafters require a side cut so they will fit into the other members into which they are framed.

Tail Cut—The tail cut is the cut on the end of the rafter. It may be any angle desired.

Overhang—The overhang is the continued length of the rafter extending beyond the outside of the building.

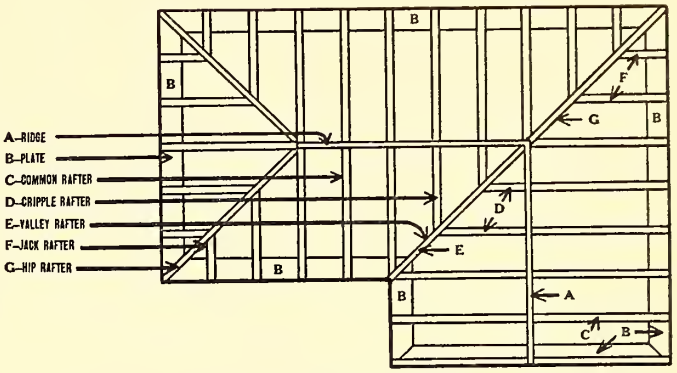


Fig. 7.

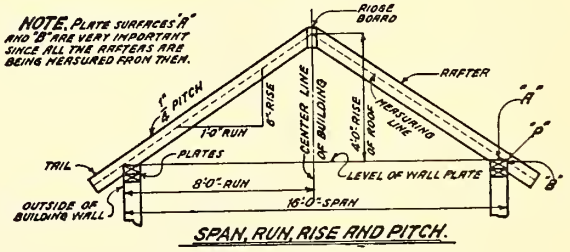


Fig. 8.

Standard Roof Pitches

Pitch	Numbers to use on the square. Run	Rise
1/12	12″	2″
1/8	12″	3″
1/6	12″	4″
1/4	12″	6″
1/3	12″	8″
1/2	12″	12″
3/4	12″	18″

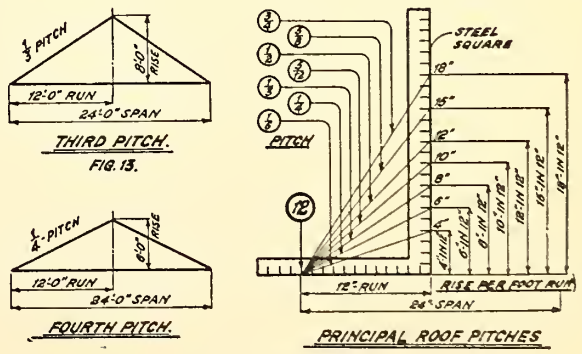


Fig. 9.

DETERMINING THE LENGTH OF RAFTERS

There are a number of different ways to obtain the length of a rafter. Many squares carry patent tables and scales that give the length of rafters per foot of run, length of braces, board feet, measure, etc. These tables enable the carpenter to rapidly find exact length and cuts for any rafter. When a carpenter can master the tables on a given square and use these tables from day to day they are a great help, but they do not give the principle involved in cutting rafters.

The length of rafters may be obtained in several different ways such as:

1. The square root method.
2. The scale method.
3. The stepping method.

By the square root method the square root of the sum of the square of the run and rise will give the true line length of the rafter.

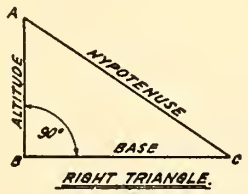
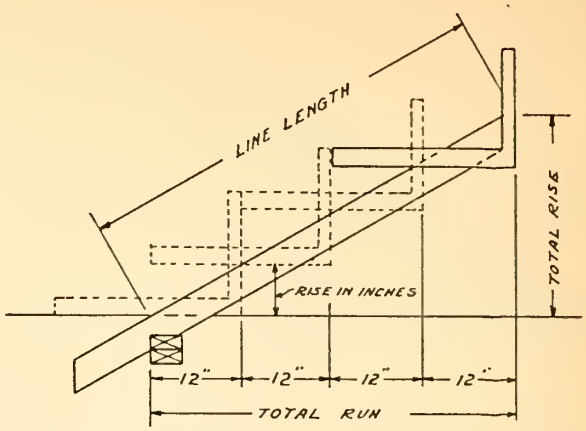


Fig. 10.

By the scale method the distance is measured from 12 on the square to the figure that represents the rise. This line is the hypotenuse of the right triangle. Then the length of this line is multiplied by the number of units of run for the rafter. For example, if a building is 12′ wide with a gable roof and it is desired to cut a rafter using 1/4 pitch the distance measured on the square between 12 and 6 would be found 13.42 inches. This multiplied by six would give the true length of the rafter. Then it would be necessary to use 12 and 6 on the square to get the plumb and level lines.



STEPPING-OFF METHOD.

Fig. 11.

Measuring Rafters

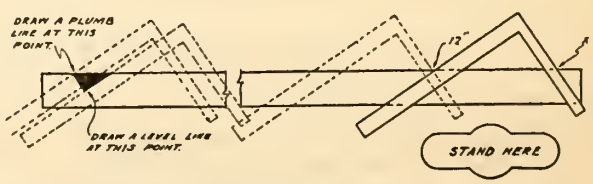
The "stepping-off" method is the easiest and most practical of the three. It is based on the unit of run (12 in.). With the gauges on the steel square set to the cut of the roof, place the square in position on the top edge of the rafter stock as shown in Fig. 11. Next, draw a line at each outside edge of the tongue and blade of the square. The length of this line is the length of the common rafter for 1 foot of run.

For two feet of run the square should be moved to the second position. For three feet of run the square should be moved to the third position, etc. Stated as a rule, "move the square as many times as there are total feet of run, marking each position carefully so as to get accurate results."

CUTTING A COMMON RAFTER

Begin at the upper end of the rafter with the bottom side away from you. Lay the square on the material as shown in the Fig. 12. Mark both edges of the square. Shift the square to the next position and mark. Continue this process until the square has been moved as many times as there are total feet in the run. When the square has been moved the required number of times, mark a plumb line. This line will be parallel to the ridge cut.

If the ridge board is used it will be necessary to subtract ½ of its thickness from the length of the rafter. This distance must be taken perpendicular to the plumb line at the ridge and not down the line length of the rafter.



STEPPING-OFF METHOD.

Fig. 12.

After the required number of steps are made, move the square as if you were going to take one more step and mark the outside plumb line. Measure up on this line the desired distance to be notched out and mark. Then move the square forward and draw a level line at that point. Another way of notching is shown in Fig. 15.

The overhang is the continued line length of the rafter and usually ranges from 6 to 24 inches on small buildings. Several different kinds of cuts may be made on the end of the rafter. A plumb cut is popular among most carpenters.

For the fractional part of the unit of run the same principle can be applied. Place the square in position, but instead of marking at the blade edge of the square, mark at any one of the inch marks, along the blade, depending upon the fractional part of the foot desired.

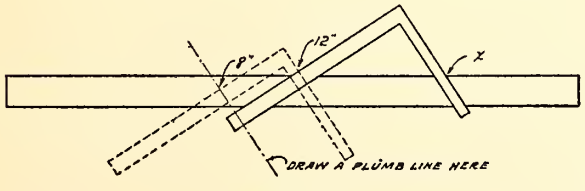


Fig. 13.

To Illustrate:

For a roof that has a total run of 10 feet and 8 inches, step off for the 10 feet as usual. Next shift the square as shown and mark at the 8 inch point. A plumb line at this place will then give 10 feet and 8 inches of run.

Questions on Roof Framing and Rafter Cutting

1. What are the most common kinds of roof coverings found in your community.

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   ....

2. List three advantages of the use of wooden shingles.....

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3. List three disadvantages of wooden shingles.

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4. List the kinds of shingles on the buildings on your farm and note their condition.

   Buildings Kind of Shingle Condition

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5. What are some of the causes of leaky roofs?

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6. How would you proceed to repair a leaky roof?

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   .....

7. What determines the life of a roof?.....

   .....

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   .....

8. List several kinds of shingles obtainable from your local lumber dealer and give price per square.

Kind of Shingle	Price per Square

9. What is meant by pitch?.....

.....

10. What are the most common pitches used for farm buildings in your community?.....

.....

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11. What does the pitch of the roof have to do with its efficiency to shed water?.....

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12. What kinds of materials are usually used for rafters?.....

13. What is the purpose of the overhang on a building?.....

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14. What is the purpose of the seat cut on a rafter?

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15. What is the purpose of the ridge board in a roof?

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16. What are the advantages of a steel square for framing a roof?.....

.....

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Problems

1. Using the formula, pitch is equal to rise divided by two times the run, $P = \frac{r}{2R}$, find the height of a roof which would be r, on a building which is 26 feet wide and having a pitch of ¼.

   Answer:.....

2. Same problem as above using a 1/3 pitch.

   Answer:.....

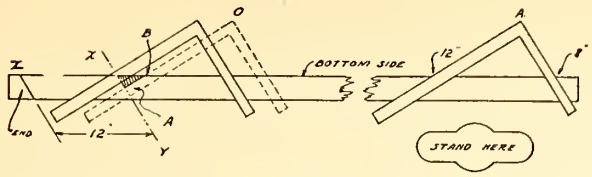


Fig. 14.

A Gable Roof

Cut a common rafter for a building that is twelve feet wide using 1/3 pitch. Notch out two inches deep for the seat cut. (The two inches are taken along the plumb line.) Allow twelve inches overhang. (Take this measurement along the line of the rafter). The ridge pole at the center is ¾ inches wide.

Place the square on the material as shown in Figure 14. Use 8 in. on the tongue and 12 in. on the blade of the square. Mark both plumb and level cuts. Measure back 3/8 of an inch perpendicular to the plumb line for the ridge pole. Make the six steps with the square. (In marking be very accurate as the width of the pencil mark six or seven times may cause the rafter to be too long or too short.)

When the sixth step is made, mark the point X. At this point using 8 and 12 on the square, draw the plumb line xy. Measure up two inches on this plumb line. Again using the same figures on the square, slip the square to the position O and mark the level line AB, or use the method suggested in Fig. 15. This is the notch to be cut out and will fit on the plate.

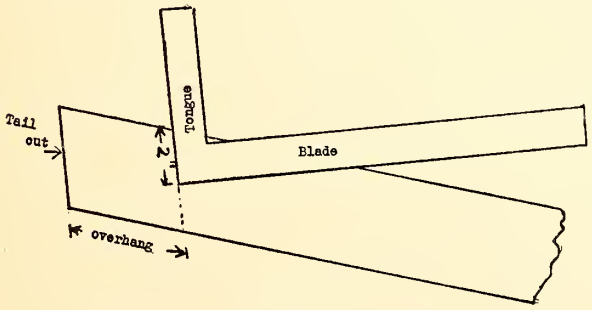


Fig. 15.

Measure down the rafter 12 inches for the overhang and mark a point Z. At this point draw a plumb line. This is the tail cut of the rafter.

Shed Roof Rafter

Cut a shed roof rafter for a building that is eight feet wide using 1/4 pitch. Notch out two inches deep for the cuts on the top and bottom plates. The overhang at the bottom of the rafter is 12 inches and eight inches at the top. Make a plumb cut on each end of the rafter.

Using 6 and 12 on the square, place it on the material in position A, Fig. 16. Mark a plumb cut. Measure down the rafter 8 inches for the overhang at the top. Place the square in position B. Mark another plumb cut. Measure 3-5/8 inches perpendicular to the last plumb line. (This is for the top seat cut.) Place the square in position C and draw another plumb line HO. Measure down this plumb line two inches and draw a level line RK, or use the method described in Fig. 15 for seat cut. The distance from R to K will vary as to the pitch used.

Then with the square in position B, using 6 inches on the tongue and 12 inches on the blade, take eight steps. At this point draw another plumb line. Then the square will take the position D in Fig. 17. Measure up this plumb line two inches for the seat and draw a level line. The square is then in position F. From the plumb line at N measure down the line length of the rafter for the overhang, 12 inches and draw another plumb line for the tail cut.

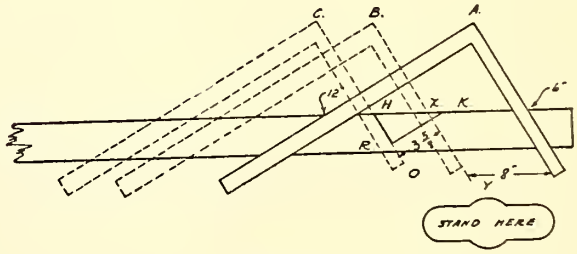


Fig. 16.

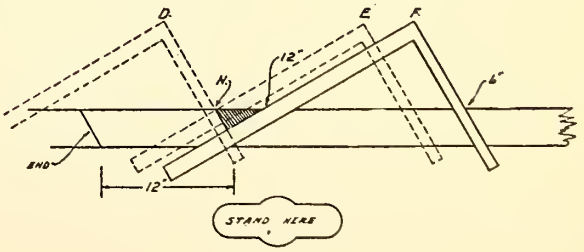


Fig. 17.

RAFTER CUTTING

Job Specification

To lay out and cut common and shed roof rafters

Materials and Equipment

Two pieces of 2″ x 4″ x 8′, square, and cross-cut saw.

Procedure

1. Two students should work together, using the work bench for the span of the building.

2. Cut two common rafters for a building with the following specifications:
   a. Width of building same as work bench.
   b. Pitch 1/4.
   c. Notch out 2″ deep for the seat cut (Vertical).
   d. Overhang 6 inches.
   e. Plumb cut on the end.
   f. Ridge pole is a 2″ x 4″ piece of material.

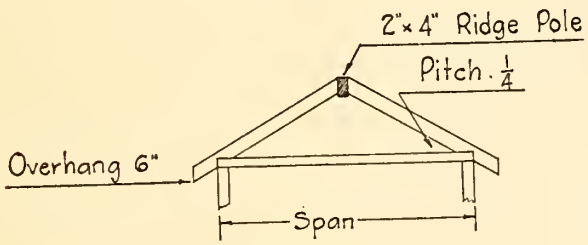


Fig. 18.

3. Place the square on the upper end of the rafter using 6″ on the tongue and 12″ on the blade. (Care should be taken in marking so as not to overstep.)

4. Step the rafter as many times as there are feet in the run.

5. Add the fractional part of the unit of run if there is any to be added. (To be added perpendicular to last plumb line.)

6. Mark back ¾″ at the ridge (perpendicular to the plumb cut) for the ridge pole.

7. Notch out for the seat cut at a 90 degree angle. See Fig. 15.

8. Add the overhang down the line length of the rafter.

9. Mark plumb cut on the end of the rafter.

10. Saw the rafter cuts carefully with a cross cut saw.

CUT A SHED ROOF RAFTER FOR A BUILDING

a. Width 6 feet.

b. Overhang at top 5 inches.

c. Overhang at bottom 5 inches.

d. Pitch 1/6.

e. Notch out (vertical) 2″ deep for seat on each plate, see Fig. 15.

f. 2″ x 4″ plates are used.

g. A plumb cut on each end of the rafter.

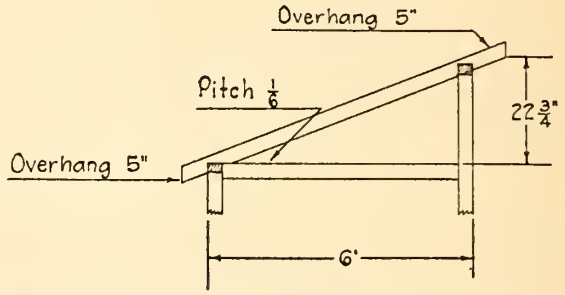


Fig. 19.

1. Mark the upper plumb cut by using 4″ on the tongue of the square and 12″ on the blade.

2. Measure down the line length of the rafter 5″ to make another plumb line. This line will correspond to the outside of the building.

3. Measure back 3-5/8″ perpendicular to the last plumb line for the top seat cut. Make another plumb line at this point. Measure up on this line the desired depth of seat, cut and notch out at an angle of 90 degrees. See Fig. 15.

4. From the second plumb line start stepping and make six steps. At this point draw the plumb line and notch out the required depth.

5. Add the additional overhang and make a plumb line on the end.

6. Cut out the rafter, using a cross cut saw.

Note

If the piece of material used for the rafter is curved the convex side should always be up.

The rafter pattern should always be rechecked for accuracy.

ADDITIONAL PROBLEMS

Common Rafters

Width of Bldg.	Pitch	Depth of Notch	Ridge Pole	Overhang
10′	1/3	2″	2″ x 4″	12″
14′	1/2	2½″	0″	14″
20′	1/4	2″	2″ x 4″	10″
8′	1/6	2″	2″ x 4″	10″

Shed Roof

Width of Bldg.	Pitch	Depth of Notch	Plates	Overhang
8′	1/8	2″	2″ x 4″	12″
6′	1/10	1½″	2″ x 4″	10″

References

Roof Framing—Rees and Nelson.
Cyclopedia of Construction—Radford.
The Steel Square—Sargent.
Carpentry—Griffith, Pp. 49-57.

CUTTING A SHED ROOF RAFTER WHERE RISE AND RUN IS GIVEN

To cut a shed rafter where the rise and run is given use the true rise and true run. Divide these into some convenient units and start stepping from the inside of the plate.

For example on a shed roof of a 10 foot building and where the top plate is to be 24 inches higher than the rear plate, use 24 inches over 116.37. Divide by 6. This will give 4 and 19.4 to be used for the numbers on the square. It will be necessary to make six steps and start stepping from the inside top plate.

Hip and Valley Rafters

The total rise of the hip and valley rafters is the same as that of the common rafters, but the run is different. The hip or valley rafter runs at an angle of 45 degrees to the common rafter. The true run of the hip rafter is 16.97 inches as compared to 12 inches of run on the common rafter, but for practical purposes the number 17 is used on the square.

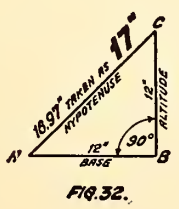
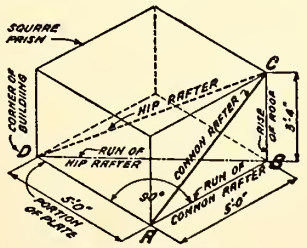


FIG. 32.



RELATIVE POSITION.
FIG. 33.

When measuring the hip or valley rafter the same figure is taken for the rise as that of the common rafter, but 17 is used on the blade for the run. The length is obtained in the same way as that of the common rafter. (Taking the same number of steps as for the common rafter.)

The deduction for the ridge is the same as that for the common rafter except that half the diagonal (45 degrees) thickness of the ridge must be used. (Where the ridge is a 2 x 4 deduct 1-1/8″.)

The length of all hip and valley rafters must always be measured along the center of the top edge or back. The rafters with a tail or eave are treated similarly to common rafters as mentioned before, except the measurement or measuring line is the center of the top edge.

1. Mark plumb line by using the rise and 17.
2. Deduct 1-1/8″ for the ridge.
3. Square across top of rafter.
4. Use center of line drawn across top of rafter for the working point.
5. Through this point make side cuts, by applying the rule below or using the standard figure for side cuts given for hip rafters.

Plumb and Level Cuts of Hip Rafters

Rule: The rise of the roof on the tongue and the run of the hip on the body will give the plumb and level cuts for any hip rafter (any pitch). The tongue gives the plumb cut and the body gives the level cut.

Standard Figures for Plumb and Level Cuts of Hip Rafters

For 1/4 pitch take 6 on the tongue and 17 on the body.

For 1/3 pitch take 8 on the tongue and 17 on the body.

For 1/2 pitch take 12 on the tongue and 17 on the body.

The tongue gives the plumb cut and the body gives the level cut.

Side Cuts of Hip Rafters

Rule: The run of the hip on the tongue and the length of the hip on the body will give the side cut for any hip rafter. The body (or length) gives the cut.

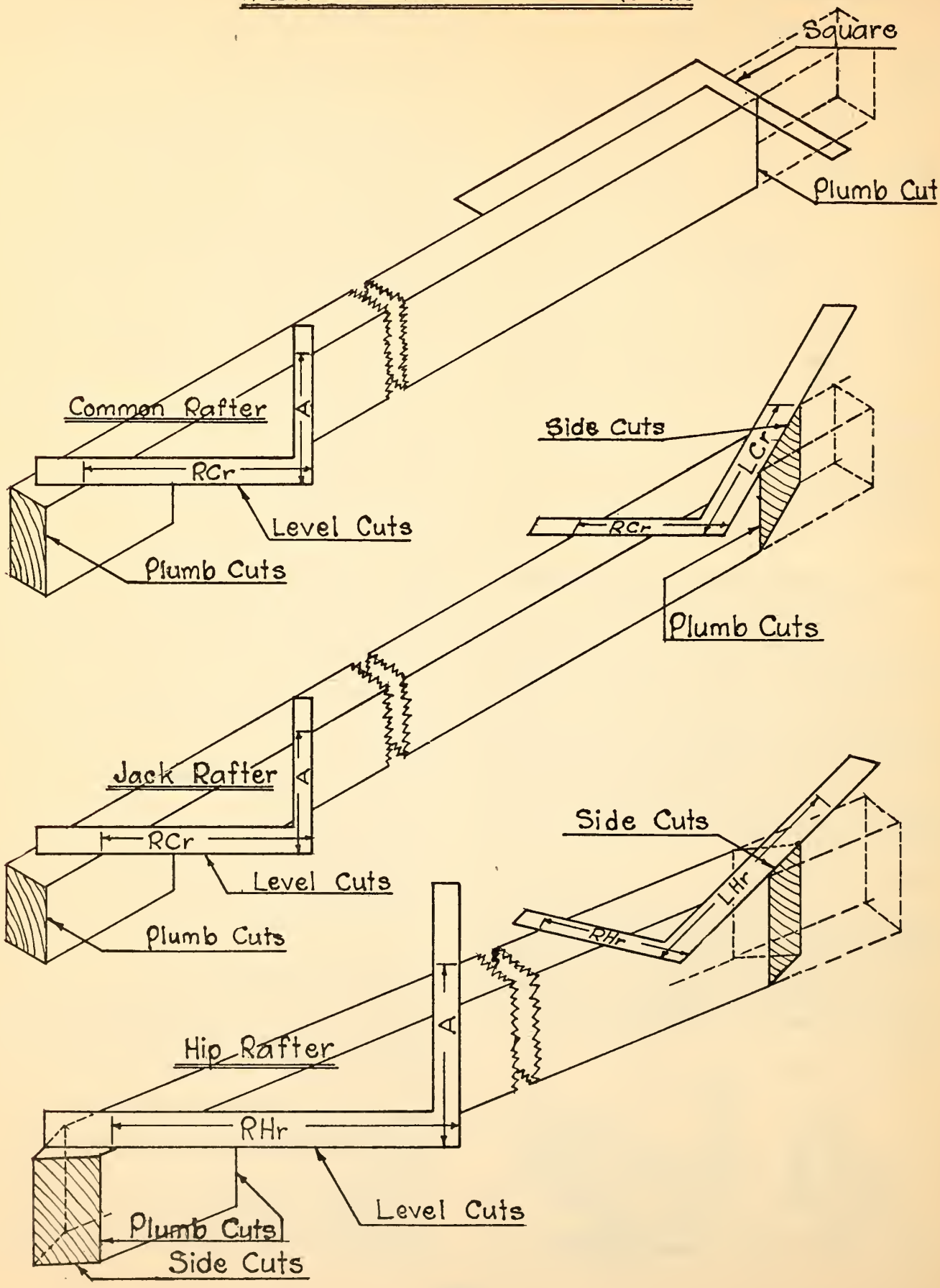
Standard Figures for Side of Hip Rafters

For 1/4 pitch take 17 on the tongue and 18 on the body.

For 1/3 pitch take 17 on the tongue and 18¾ on the body.

For 1/2 pitch take 17 on the tongue and 20¾ on the body.

Method Of Applying Square



Valley Rafters

Valley rafters have the same plumb cut, level cut, and side cut as hip rafters, and also have the same length and are therefore laid out by the same rules as hip rafters.

Finding the Fractional Part of the Unit of Run on a Hip Rafter

It has been shown how to find the fractional part of a unit of run on a common rafter. To find this on a hip rafter take the number of inches used on the common rafter on each side of the square and the diagonal will be the correct number in inches to use. (This additional length is to be added on a horizontal line.)

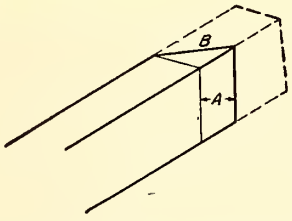
Plumb and Level Cuts of Jack Rafters

The plumb and level cuts of jack rafters are the same as for the common rafters. (See directions for plumb and level cuts of the common rafters.)

Side Cut of Jack Rafters

Rule: The run of the common rafter on the tongue and the length of the common rafter on the body will give the side cut for any jack rafter of any pitch. The body (or length) gives the cut.

Standard Figures for Side Cut of Jack Rafters



For 1/4 pitch take 12 on the tongue and 12-7/16 on the body.

For 1/3 pitch take 12 on the tongue and 14-7/16 on the body.

For 1/2 pitch take 12 on the tongue and 17 on the body.

The body gives the cut.

Length of Jack Rafters

First method: Divide the length of the common rafter by one more than the number of jack rafters required. This will give the length of the shortest jack rafter, the second jack rafter will be double this length, and the third will be three times as long as the first, etc.

Second method: The length of a jack rafter for 1/4, 1/3, or 1/2 pitch can also be obtained by multiplying its run by the number used for finding the length of the common rafter of the same pitch as the required jack rafter.

The run of any jack rafter is easy to find, as it is always equal to the distance between the corner of the building and the point at which the jack rafter is placed.

Difference in Length of Jack Rafters

	16″ Centers	24″ Centers
For 1/4 pitch	17-7/8″	26-7/8″
For 1/3 pitch	19-1/4″	28-7/8″
For 1/2 pitch	22-5/8″	34-00″

A Cripple Rafter

A cripple rafter is a rafter "having no foot," or no foot on plate (as cripple rafter D, shown in illustration of roof-frame, resting top at ridge and bottom of valley rafter) running between ridge and valley; sometimes between hip and valley.

Cripple-rafter length is that of the jack-rafter plus length necessary for its bottom cut, which is a plumb cut like top cut.

Top and bottom (plumb) cuts of cripples are same as top cut for jack rafter.

Side cut at hip and valley same as side cut for jacks.

Questions:

What is the purpose of a hip rafter?.....

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Why is the seat cut on a hip rafter usually cut a little deeper than the seat cut on the common rafter?.....

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Why do you use 17 on the blade of the tongue for cutting a hip or valley rafter?.....

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PAINTING

Farm buildings, machinery, and equipment are depreciating thousands of dollars daily due to the lack of proper painting. Painting at regular intervals is the cheapest way to keep buildings and implements in first class condition. In different sections of the country there is more or less depreciation on buildings due to climatic conditions. In the western arid sections lumber will last much longer than it will in a wet or hot climate.

Paints not only act as a preservative coat on wood or metal but also serve to beautify and decorate the homestead. Colors in paint tend to make the place look attractive. It also adds value from a sales viewpoint.

When to Paint

All new jobs should receive a coat of paint as soon as possible. Siding on a house should be given a priming coat immediately after it is put on. The pores of the wood should not be allowed to open. An application of paint will prevent this. The longer a paint job is put off, the more costly it is, since it will require more paint and more time for applying it.

New galvanized iron should be allowed to weather for about a year. If it is to be painted soon after it is put on, it should receive an acid bath, or should be painted with a coat of vinegar. This will provide a foothold for the paint.

Time to Paint

The best time to paint is when the temperature is between 60 to 70 degrees F., and there is very little wind to move the dust. At no time should a surface be covered with paint if it is damp or wet. Moisture sealed under the paint will tend to push it off.

Outside Painting

Most of the paint used on the farm is applied on outside surfaces. Outside paint differs from that used on the inside as it must stand both the rain and the sunshine. For that reason it must be made of different materials.

All paints, whether mixed on the job or bought ready mixed, consist of a solid (the pigment) and a liquid (the vehicle). The finely-ground pigment is mixed with the vehicle. As the paint is applied to the surface, the solids are evenly spread and are bound by the vehicle. The solids give the color to the paint.

Pigments

The common pigments for paint are white lead, lead sulphate, zinc oxide, and lithophone. Lithophone contains about 30 per cent zinc sulphide and 70 per cent barium sulphate. There are many other cheap pigments used in paint. Colored pigments are added to white pigments to produce tinted paints.

Vehicles

The vehicle in oil paints is usually linseed oil (made from flax-seed). A little liquid drier and thinner is added. The linseed oil changes from a liquid to a solid after drying several days. There are two kinds of linseed oil sold on the market, raw and boiled. The raw is used for outside painting while the boiled is used on inside work.

Paint Thinner

Paint is usually thinned with turpentine. The thinner makes the paint spread more easily and the oil penetrates porous surfaces more readily, but if used in large quantities it will make the paint less glossy, giving the surface a dull or flat finish.

Gasoline or kerosene should not be used as paint thinner, as gasoline evaporates too quickly and kerosene too slowly.

Outside Paint

A good formula for outside paint is as follows:

White lead paste	100 pounds
Raw linseed oil	2 gallons
Japan drier	1 pint
Turpentine	1 pint

(The above stock will make 7 gallons)

The Priming Coat

The priming coat is the first coat of paint. It is made by taking a gallon of ready-prepared paint and adding about two quarts of linseed oil and one half pint of turpentine or Japan drier.

The priming coat should be applied as soon as the job will permit. This first coat will keep out the moisture and seal the pores in the wood. It is important to bear in mind that several thin coats of paint give better results than a few heavy coats.

A three coat job consisting of a priming coat and two heavier coats will usually prove highly satisfactory.

Most paint jobs are rushed and not enough time is given between coats for the paint to dry thoroughly. The weather will determine how fast the paint will dry. A fair average of opinions will put the time from two to three weeks.

Inside Paint

New Work: The service that inside wall paints are called upon to perform differs greatly from the service that is expected from house paint; consequently, the two types of paint are fundamentally different in formula. House paint is comparatively soft, slow drying and long in oil and presents a shiny surface. Flat wall paints, on the other hand, are short in oil, present a flat surface when dry, dry more quickly than house paint and often contain considerable amounts of varnish to make them hard and increase their flow. They will not successfully withstand out door ex-

posure, but should be proofed against repeated washings with soap and water. They may be applied over practically any material of which walls in a house are commonly made.

Inside paint or flat wall paint contains a heavy base and volatile liquids are used for the vehicle. This permits the pigments to settle rapidly and the vehicle evaporates quickly. Quick drying inside paints are becoming very popular.

Color in Paint

Although the choice of color is almost entirely a matter of taste and therefore most decidedly controversial, there are certain colors the effect of which upon the human mind has been scientifically determined. Chief among all colors in its subconscious effect upon people is yellow. Yellow, to a greater degree than any other color is conducive to cheerfulness. It is the scientifically correct color for the walls of children's rooms and for the rooms of convalescents. Strong colors on large areas are apt to be difficult to live with and will usually become tiresome. Green is restful and blue is depressing.

Quality of Paint

It never pays to buy cheap paint. Before purchasing paint, one should look at the formula on the can and see that it contains those things that make up quality paint, proportioned in the right manner.

Farm Implement Paint

Paint for farm machinery and implements should dry harder and give a more water resistant coat than ordinary paint. This type of paint usually contains varnish as a part of the vehicle, is sold on the market as "Implement Paint" and should be used instead of ordinary house paint.

Formula for a good farm implement paint:

Pigment ground in Japan.....5 pounds
Outside spar varnish.....2 pints
Turpentine.....1 pint

How to Prepare Surfaces for Painting*

Wood: New unpainted wood usually needs very little preparation. Dusting off loose dirt, removing mortar, plaster, or cement with a scraper or sandpaper, and filling nail holes and loose joints with putty after the priming coat is dry may be sufficient. If the wood is resinous or waxy or contains knots and coarse grain figures full of rosin or pitch, however, special treatment is necessary. Charring with a blowtorch will kill the pitch in knots, but the usual method is to apply a thin coat of orange shellac to all pitchy places before the surface is painted. Resinous wood like yellow pine should be brushed over with turpentine just before it is painted; cypress should be brushed over with solvent naphtha or benzol.

A painted surface that is simply chalky needs only to be dusted. All paint that has begun to scale or peel must be removed by scraping or brushing with a wire brush; more adherent paint that is checked may be softened with a blow torch and then scraped off. All loose putty should be removed from nail holes, joints, and cracks, and fresh putty put in after the first coat of paint has dried.

Surfaces that have been varnished or enameled should be rubbed with fine sandpaper, curled horsehair, or fine steel wool until the gloss is removed. If such surfaces are marred, prepared varnished remover should be used, smoothing the wood after it is dry with steel wool or sandpaper. Painted or varnished woodwork in kitchens and bathrooms should be washed with soap and water and then thoroughly sponged with clean water. Floors that have been treated with nonvolatile mineral oils can not be painted or varnished.

Shingles or other wooden surfaces that have been treated with creosote or creosote stains cannot be painted until they have weathered for several years.

Wood that has been whitewashed can not be painted until the whitewash has been removed as completely as possible.

Surfaces that have been coated with tar or other bituminous materials should be coated with shellac varnish before they are painted with oil paints. If soft, such surfaces should be coated with sand before they are painted or whitewashed.

How to Estimate the Quantity of Paint Needed

The condition of the surfaces to be painted will govern the spreading rate of paint. The quality of the paint will also figure in estimating. Most of the paint sold is ready mixed and in case the amount is not figured correctly it can be returned.

Below is a spreading rate chart taken from United States Department of Agriculture Bulletin No. 1452:

Coating Material	Character of Surface	Surface Covered by One Gallon of Paint	
		1 coat	2 coats
		Sq. ft.	Sq. ft.
Oil Paint (gloss finish)	Smooth wood	600	325
	Rough wood	350	200
	Metal	700	340
	Plaster	450	250
	Hard brick	400	225
	Soft brick	350	200
	Smooth cement	350	200
	Rough cement (Stucco)	200	100
Oil Paint (flat finish)	Smooth wood or wallboard	500	275
	Plaster	400	225
	Hard brick	350	200
	Soft brick	300	175
	Smooth cement	300	175
	Rough cement (Stucco)	150	75

*(Farmers' Bulletin 1452)

Coating Material	Character of Surface	Surface Covered by One Gallon of Paint	
		1 coat	2 coats
		Sq. ft.	Sq. ft.
Enamel paint	Smooth painted with under coats	500	250
Exterior spar varnish	Smooth wood	500	275
Interior finishing varnish	Smooth wood	450	250
Shellac	Smooth wood	600	300
Shingle stain*	Rough wood	125	75
Asphalt roof paint	)Smooth	250	
	)Rough	150	
Asphalt-asbestos liquid roof cement	Smooth	100	
Cold-water paint (5 lbs. powder)	Smooth	300	
Calcimine (5 lbs. powder	Plaster	400	
Whitewash (4 to 5 lbs. hydrated lime)	)Wood	250	
	)Brick	200	
	)Plaster	300	

*2½ gallons per 1,000 shingles when dipped two-thirds their length.

Varnish

The main ingredients of varnish are fossil gum, oil, and thinner. The fossil gum is the product of hardened sap of trees which have been buried under the ground for thousands of years. It is found mostly in Africa and South America. The oils used in making varnish are linseed oil and china wood oil. To these ingredients is added a "drier" which is composed of lead and manganese.

Quick drying varnishes have become very popular. They will dry hard in four hours compared to twenty-four to forty-eight with the slow drying kind.

A spar varnish has recently been developed. It is a tough, water proof, and heat resisting varnish. It is used extensively for finishing table tops, floors and boats, and other surfaces subjected to hard wear.

Cheap varnishes are made from resins and oils. They dry slowly, are less durable and are much cheaper. It never pays to use a cheap grade of varnish.

Most varnishes used are clear. However colors may be added, but this method does not produce as good results as where the surface is colored and then varnished with the clear varnish.

Stain

The purpose of a stain is to bring out the grain in the wood, to enrich the color, and to change the color of a cheap wood to imitate a more expensive wood. Most of the furniture today as sold on the market is stained to represent walnut or mahogany and is made from gum. Staining is the cheapest way to finish wood.

There are principally three kinds of stains: water, oil and spirits.

Oil Stains

Oil stains are made from pigment and oil. They are easy to apply and do not raise the grain of the wood. They tend to fade and do not give the clear color that some of the other stains do. They come in different shades such as walnut, mahogany, light oak, cherry and many others.

Water Stains

Water stains are made by dissolving dyes and logwood extracts in hot water. They are applied differently from oil stains in that they are put on and allowed to dry without wiping as with the oil stains.

Spirit Stains

Spirit stains are made by dissolving analine colors in alcohol. They are advantageous in refinishing old furniture as they penetrate deeper than the other stains.

Applying Stains

Stains should be applied with a rubber set brush. Select the stain that is suitable for the job, before applying it. Try out a sample on a similar piece of wood and study the effect. If the stain is too dark, then add more thinner. If too thin, add more pigment.

Oil stain should be removed with a soft cloth after it has set a minute or two. The surface should be rubbed with the grain.

When applying water stains, remember that the wood should be dampened before the stain is applied. After stain is applied, allow it to dry for two hours and sand with a fine sand paper.

Spirit stains penetrate the wood very rapidly and should be applied evenly. As they dry very rapidly, much time is saved by their use.

Shellac

Shellac is an animal product. It is produced by a small insect found in the East Indies, China and other Asiatic countries.

The insects feed upon resinous juices of certain types of trees. After the female lac bug has laid her eggs, she dies, and when the young come out they secrete the lac. After a long period of time, there is a coat of this secretion about one-half inch thick on the limb of the tree. This coat is stripped off the trees by the natives. It is ground, sifted and washed. The water takes out the coloring matter which is used in making scarlet and crimson dyes. There are about 40,000,000 pounds of shellac harvested each year.

Alcohol is used to dissolve the shellac. From four to six pounds of the lac powder is dissolved

in one gallon of alcohol; which is then known as shellac. There are two kinds of shellac: orange (natural color), and white (where the orange has been bleached).

Shellac has many uses. It is very important in the furniture industry. It is just as important in the electrical industry and in the manufacture of many other articles, such as buttons, combs, pencils, straw hats, etc.

All knots on outside work should be shellaced before painting. The shellac will keep the pitch or resin from coming through the paint.

Shellac is not as durable as varnish, as it will crack, peal and scratch.

The proper thinner for shellac is denatured alcohol and no other thinner should be used.

Never apply shellac over varnish as the alcohol in the shellac will tend to penetrate and remove the varnish, but varnish may be applied over dry shellac.

The main advantage in the use of shellac is that it dries quickly and will speed up the finish on a job.

Shellac should be applied in thin coats.

Brushes that have been used in shellac should be cleaned by washing in alcohol. After washing well, they may then be washed with warm soapy water.

Enamel

Enamel is made by taking a flat paint and adding varnish. There are high grade enamels sold on the market, and for best results it is advisable to purchase a standard brand enamel.

Enamel is used as a final coat on interior trim, furniture, cabinet work and metals. It dries rapidly, gives a high gloss, but does not cover as well as paint. The correct thinner for enamel is turpentine.

Paste Fillers

Many woods that have open grains may require a paste filler. There are many commercial paste wood fillers on the market. The fillers are usually composed of silex, linseed oil, Japan drier, turpentine, and colors ground in oil.

The paste fillers are used also to fill cracks, checks, nail holes, dents and other imperfections.

When applying a paste filler, remember that it should be rubbed across the grain, rubbed off well, and allowed to dry for twenty-four hours.

Plastic wood, stick shellac and putty are also used as fillers.

Wax and Floor Oil

Wax and floor oil are best applied with a rag and rubbed well into the wood, while varnish is applied in the regular way and may be waxed when thoroughly dry. If the floor is varnished, a week, if possible, should be allowed before the floor is used, for any marks or deep scratches that occur while the varnish is soft may penetrate to the wood and necessitate a complete refinishing job.

Paint Brushes

There are many different kinds and grades of paint and varnish brushes. It will pay to buy a good brush if there is a good deal of work to be done. Rubber set brushes are always to be preferred.

There are several different methods of caring for a paint or varnish brush. Anyone of these methods is regarded satisfactorily.

Method No. 1: Wash brush with turpentine or gasoline. Suspend brush in linseed oil.

Method No. 2: Wash brush with turpentine or gasoline. Wash with warm soapy water and store dry.

Method No. 3: Wash brush with gasoline or turpentine. Dip brush in linseed oil, then wrap in heavy brown paper. With this method, the brush should be used at least once a month.

Method No. 4: Wash brush with warm water and soap, dip in linseed oil and suspend in water.

Method No. 5: Painters who work daily with the same brushes keep them in water over night. When a job is completed, they use one of the above methods for cleaning and storing their brushes.

Brushes used in shellac or lacquer, must be cleaned with alcohol or a lacquer thinner.

Softening Old Brushes

Brushes that have become hard and dry may be revived and used again by one of the following methods:

No. 1: Soak brush over night in a commercial brush cleaner.

No. 2: Boil brush in vinegar for a few minutes and allow to soak for a few hours.

No. 3: Soak brush for twenty-four hours in a warm solution containing a pound of sal soda in three pints of water. Then wash with warm water and soap.

Calcimine and Cold Water Paints

Calcimine and cold water paints contain a lime compound (calcium carbonate or calcium sulphate) and an adhesive substance which acts as a binder. Casein is used extensively as an adhesive in cold water paints.

Cold water paints give good results for inside work where moisture does not contact the surface. They are not to be recommended for outside painting.

White Wash

White wash is made from slacked lime and water. Some other ingredient may be used to make the white wash stick better. A good formula for making a white wash to use on sheds is as follows:

Formula

38 pounds of slacked lime.
5 gallons of hot water.
(Mix above and stir vigorously.)

Pour into the lime mixture a solution made by first dissolving twelve pounds of salt and six ounces of alum in about four gallons of hot water and then add a quart of molasses.

Precautions to Take in Painting

1. Avoid breathing fumes from fresh paint as they are poisonous. Provide sufficient ventilation on inside painting.

2. Keep paint off hands. (May avoid infections.)

3. Oily paint rags should be hung on outside of house or burned. (Paint rags cause fire from spontaneous combustion.)

4. Provide substantial ladders to avoid accidents.

5. Use paint clothes for painting. (A good painter will get less paint on his clothes and more on the surface.)

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GLAZING

There are three kinds of glass to be dealt with in glazing, based on the thickness of the glass: single strength, double strength, and plate glass. Double strength is to be preferred, but most windows are made with single strength glass in them. On account of the weight of double strength glass, it is not desirable for windows larger than 36″ x 48″ in size.

In glazing, there are three operations to be done: removing old glass and putty, cutting the glass the correct size, and fastening in glass with glazier points and putty.

Removing Old Glass

The old glass should be removed and putty scraped out.

For best results after cleaning out sash, apply a coat of thin paint or linseed oil. This should be allowed to dry for a few hours. This is done to prevent the oil in the putty from being absorbed by the wood causing the putty to crumble.

Cutting the Glass

Care should be taken to see that the glass is on a flat surface to keep it from breaking. Measure the size of the glass allowing about an eighth of an inch so the glass will be a little smaller than the place to be fitted in.

Be sure the glass is clean and free from dirt and grit before cutting. A little kerosene on a rag may be used for wiping the line to be cut. Dip the glass cutter in a cup of kerosene and make one clean stroke down the line to be cut. Take care that the straight edge being held for the cutter does not move. Do not move the cutter back and forth on the line to be cut as it will ruin the cutter. Break the glass on the line by pressing on the edge of a table.

Placing in Glass

Place the glass in the sash and drive in glazier points with a heavy wood chisel, allowing the bevel of the chisel to ride on the glass.

Work the putty to the right consistency. If it is too dry, add a few drops of linseed oil. Work the putty around the edge of the glass with a putty knife. After the putty has been allowed to dry for several days, it should receive a good coat of paint.

Questions:

What do we mean by paint "blistering" and explain the cause?.....

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Compare inside paint to outside paint in regard to ingredients.....

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Questions on Painting

1. List the buildings on your farm that need painting.....

2. In what way does painting add to the value of a farmstead? .....

3. Under what conditions would you consider it profitable to paint farm buildings?.....

4. What is the purpose of painting?.....

5. What do the average painters in your community charge per hour?.....

6. How much would you estimate you could save by painting the buildings that you have listed above?.....

7. Find out from your local retail hardware dealer the prices of good paint.....

8. What would be your basis for the selection of good paint?.....

9. What factors determine the best time of the year to paint?.....

10. What is the principal difference between the first coat, considered the "primer," and the other coats?.....

11. What treatments should knotted lumber be given before painting?.....

12. List the common vehicles and paint thinners.

13. What jobs do you have in the home that need repainting or revarnishing?.....

14. What methods would you use to remove old varnish?.....

15. What are the common methods of refinishing old floors?.....

16. Why should shellac never be applied on top of varnish?.....

17. What are the common methods of cleaning a paint brush?.....

METER READING

Job Specifications

To learn how to read an electric watt-hour meter.

The watt-hour meter measures the amount of electrical energy used and records it in terms of kilowatt-hour units. The recordings are cumulative, so that in order to calculate the consumption for any given period such as a month, we must know the reading of the meter at the beginning of the period as well as at the end. As the reading at the end of the period will be the larger one, we subtract the first reading from the second to get the total consumption for the period. The power company subtracts last month's reading from this month's reading and multiplies the difference by the rate per kilowatt-hour in order to calculate your monthly bill.

When reading the meter, read the number the hand has just passed. Begin on the right side of the dial and record numbers from right to left.

Procedure

(1) Using 8c per kilowatt-hour figure the cost of energey consumed as shown on meter dials in Figure 1 and Figure 2.

(2) In Figure 3 put in dial hands to read 1487. In Figure 4 place hands to read 1556.

(3) In Figure 5 show hands to read 4829.

(4) Show hands to read 4999 in Figure 6.

(5) Calculate the cost of energy consumed.

Why should the consumer know how to read his own meter?.....

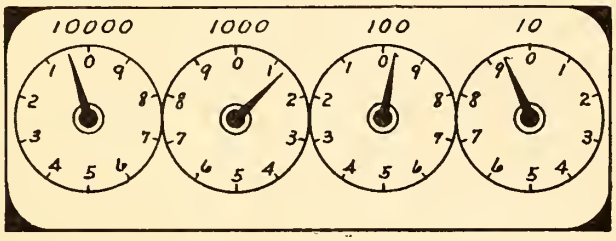


Fig. 1.

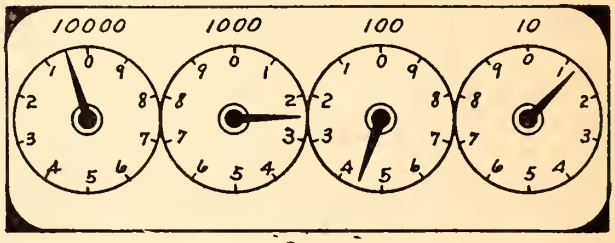


Fig. 2.

Reading last month_____ Reading this month_____

Difference in readings_____

Total Cost_____

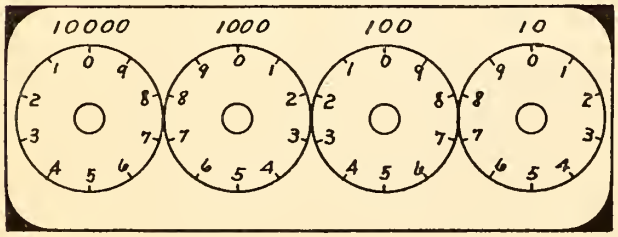


Fig. 3.

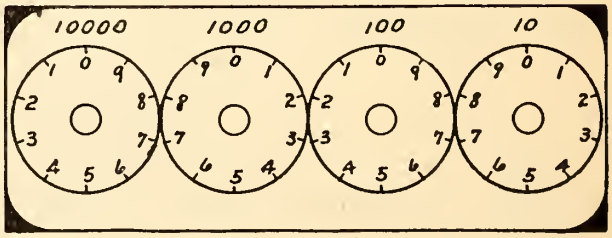


Fig. 4.

Reading last month_____ Reading this month

Difference in readings_____

Total Cost_____

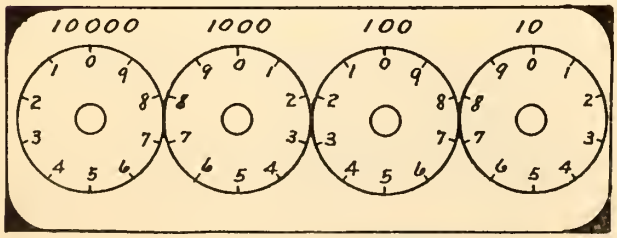


Fig. 5.

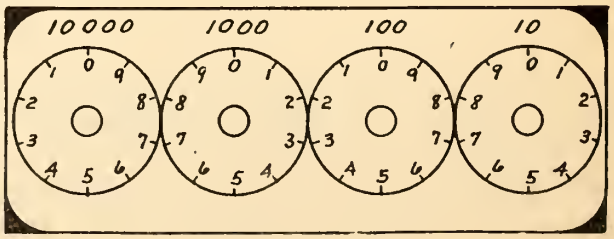


Fig. 6.

Reading last month_____ Reading this month_____

Difference in readings_____

Total Cost_____

WIRE JOINT OR SPLICE

Job Specification

To make a joint or splice using No. 12 or 14 insulated wire.

Materials and Equipment

Pliers, knife, rubber tape, friction tape, solder, paste, torch, and copper.

References

Essentials of Electric Work—Willoughby.

Fundamentals of House Wiring—Willoughby.

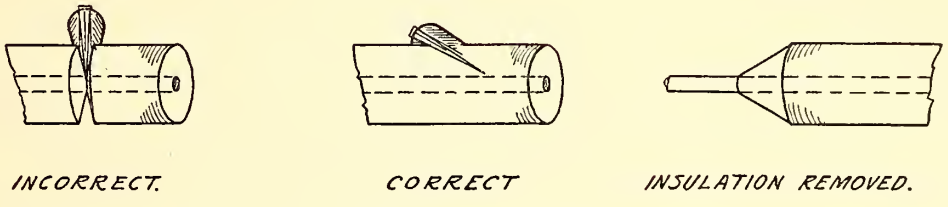
Wiring On The Farm—C.R.E.A. Bulletin.

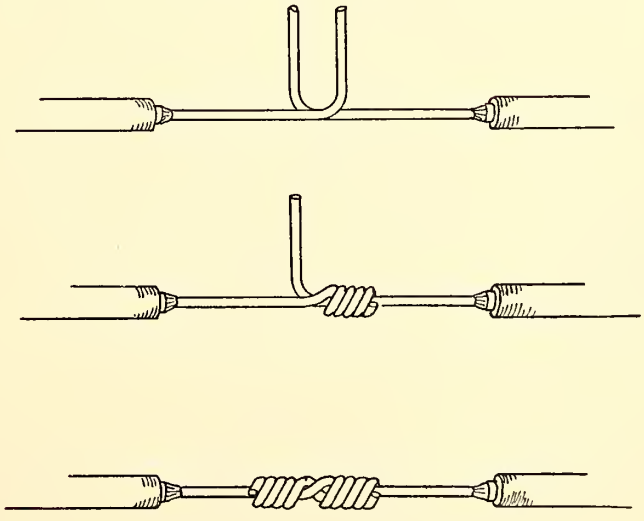
Farm Mechanics Text and Handbook—Cook, Scranton & McColly, Chapt. XLVI.

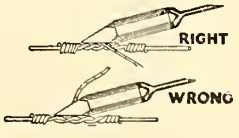
Procedure

Remove the insulation by holding the blade of the knife at an angle of about 30 degrees to the wire and force the blade parallel to the wire. After most of the insulation has been removed hold the blade at 90 degrees to the wire and scrape it until it presents a shiny appearance. Care should be taken not to cut the wire when removing the insulation.

In making a splice bend the wires at 90 degrees around each other. They should be wound around each other at least five times with successive turns being kept about 1/16 degrees apart and drawn down tight to make good metallic contact. Cut the ends off with a pair of pliers and bend down snugly against the conductor. Cover the joint with soldering paste (not acid). Apply a hot soldering copper to the wire and as soon as the wire has received enough heat to melt solder, apply a small amount of solder. Wrap the joint with rubber tape and then wrap securely with friction tape.

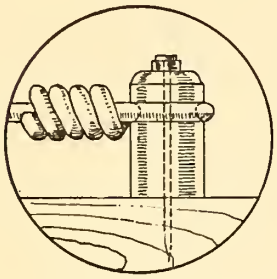






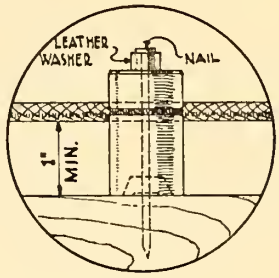
Soldering with Rosin Core Solder.

CONCEALED KNOB AND TUBE WIRING
AND
OPEN CLEAT WIRING



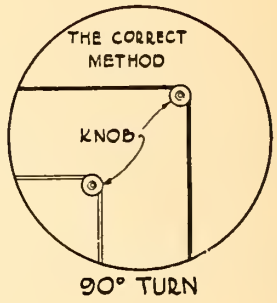
STANDARD KNOB

No. 1



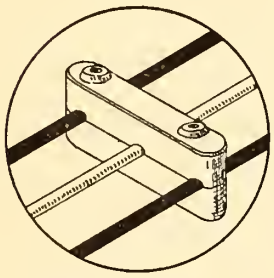
SPLIT KNOB

No. 2



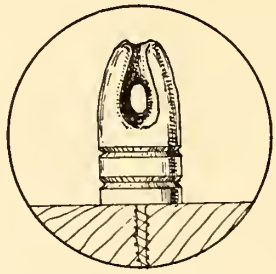
90° TURN

No. 3



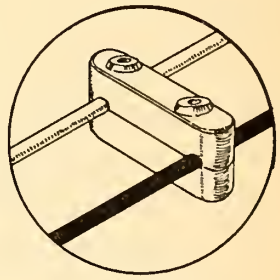
3-WIRE CLEAT

No. 4



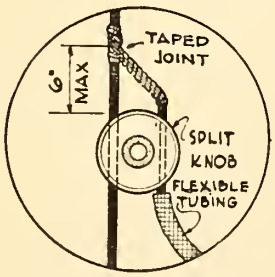
SERVICE KNOB

No. 5



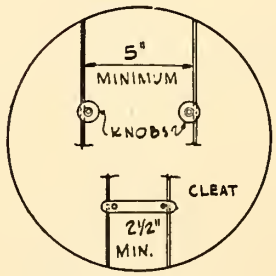
2-WIRE CLEAT

No. 6



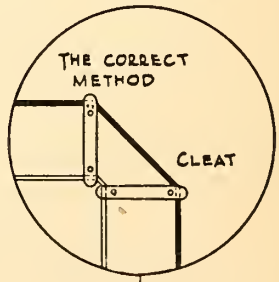
CONNECTION

No. 7



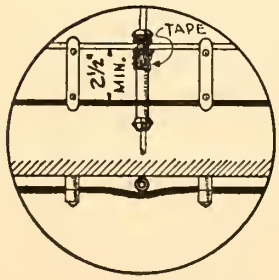
WIRE SUPPORTS

No. 8

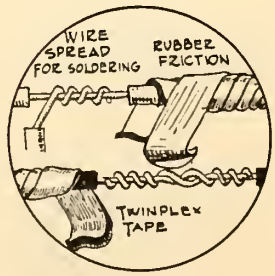


90° TURN

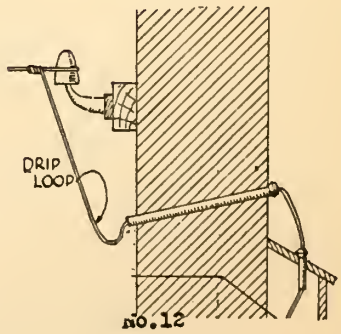
No. 9



CROSS WIRES
No. 10



JOINTS & SPLICES
No. 11



No. 12

Questions on Electricity

1. How is electricity measured?.....

.....

2. What is a kilowatt-hour?.....

.....

3. What is your electric rate?.....

.....

4. How do rates change with different amounts of electricity used?.....

.....

.....

5. List the home electric appliances that you have, and estimate the cost of each per month. (Refer to tables in back of book.)

Appliance	No. KWH used per month	Rate	Cost

6. What are the factors that will determine the efficiency of a light in a room?.....

.....

.....

.....

7. What are the common sizes of light bulbs used in the home?.....

.....

.....

8. If it costs 10 cents to burn 10—100 watt bulbs for an hour, what would be the cost of burning 5—75 watt bulbs 100 hours?

Answer.....

9. What are the factors that will determine the life of your car battery?.....

.....

.....

10. What size motors are used in the school shop?

.....

.....

11. Show by drawings how to connect up dry cell batteries in series and in parallel.

12. How are the batteries in a flash light connected up?.....

.....

13. What is the difference between A-C and D-C current? .....

.....

14. What is the purpose of a fuse?.....

.....

15. What are common sizes of fuses used in the home? .....

.....

16. Why is it dangerous to replace a burned out fuse with a penny?.....

.....

17. Name the ordinary materials needed for putting in a plug for a radio or iron.....

.....

FARM FENCING

Good fences and gates on the farm have long been recognized as a key to successful farming.

Proper handling of farm fencing problems requires careful consideration of a number of factors. Experience shows that high quality fencing materials properly erected give increased service life and efficiency in proportion far in excess of the slight extra cost. A poor fence requires but little less material than a good one and almost as much effort to build.

The first problem in a farm fencing program is the determination of proper arrangement of fields for maximum efficiency in farm operation. In general it is wise to have as few fields as practicable. Small fields require more fence per acre and also reduce available crop acreage because of inability to cultivate and harvest entirely up to the fence row. Where tractors are used in the cultivation program, long rows are desirable. However, this may not be as great an advantage with horse-drawn equipment.

WOOD POSTS

When wood posts are desired, considerable care should be used in their selection. Information Series No. 28 (1932) prepared by the Bureau of Agricultural Engineering, U. S. Dept. of Agriculture, states as follows:

"Wood posts are generally used in timbered sections, due to their cheapness compared with iron and concrete. Some wood is very durable, lasting from 8 to 20 years without preservative treatment, while certain kinds will last less than 8 years and should not be used without being given preservative treatment.

Average Life of Untreated Wood Posts (in years)

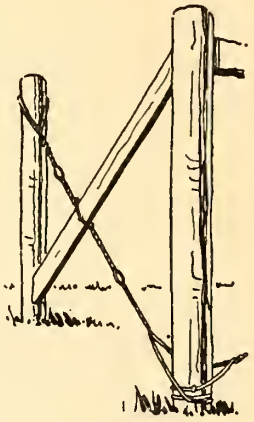
Osage Orange	30	Pine	11
Locust	24	Tamarack	10
Red Cedar	20	White Oak	11
Mulberry	17	Cherry	10
Catalpa	16	Hemlock	9
Bur Oak	15	Sassafras	9
Chestnut	15	Elm	9
White Cedar	14	Ash	9
Walnut	12	Red Oak	7
		Willow	6

"The most effective preservative for wood fence posts is creosote. The method applicable to use on the farm is described in Farmers' Bulletin 744, 'Preservative Treatment of Farm Timbers.' A copy of this bulletin can be had by applying to the Office of Publications, Department of Agriculture, Washington, D. C."

In the above discussion of the durability of various woods, it should be borne in mind that the rating applies to heart wood only. The sapwood of any species is not durable and should be avoided whenever possible. Post-split large trees will contain a smaller percentage of sap wood than when the entire small tree is used.

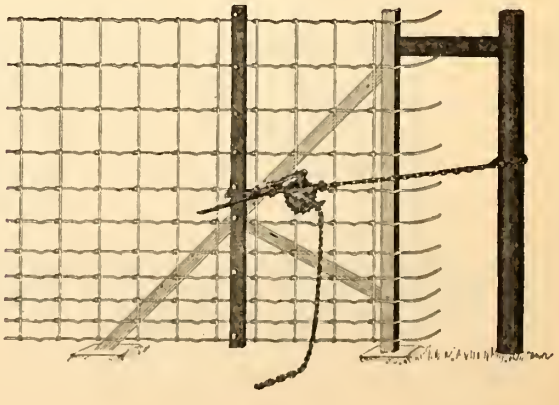
Bracing Line Posts

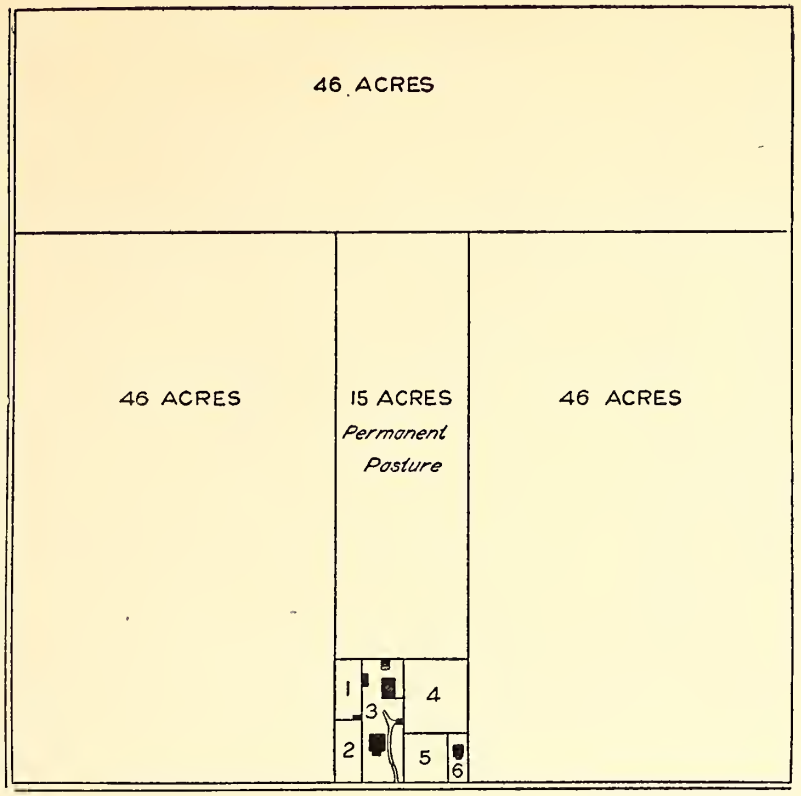
About every 40 or 50 rods in a long fence line, even on level ground, it is well to brace a line post either by setting it in concrete or by bracing as illustrated in Figure below. This will provide a steadier fence line by compensating for possibly insecure posts elsewhere along the line. In case temporary fence lines are to be run from points along the permanent fence, such bracing will also provide proper terminals for the temporary lines.



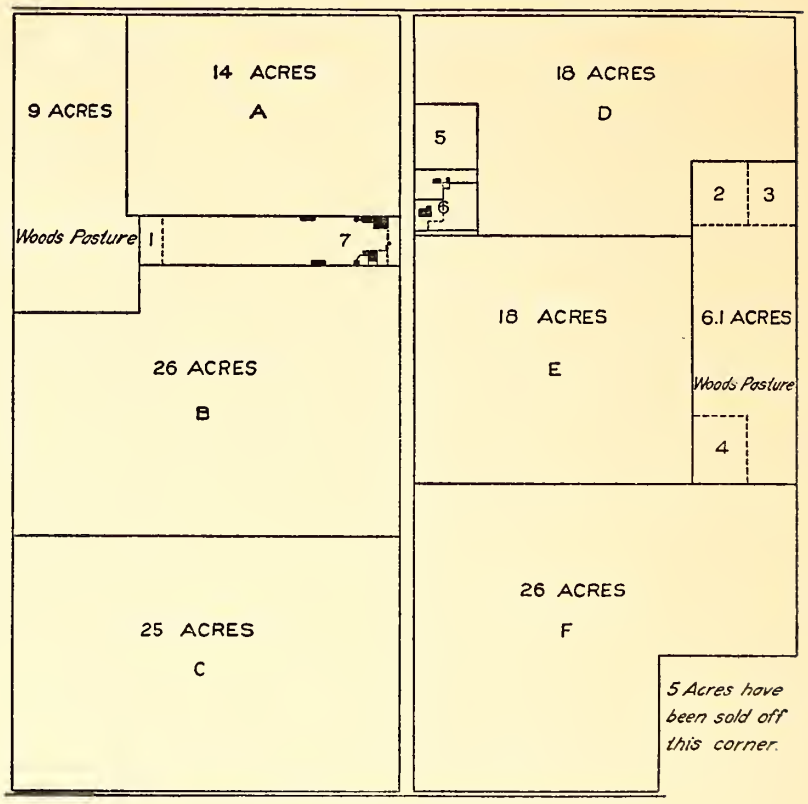
Temporary Stretching Post

A temporary stretching post (see Figure below) should always be set about 4 feet beyond the end, corner or gate post to which the fabric is to be stretched, and braced against this post as indicated in the illustration, to provide a solid foundation against the stress of stretching. Set the temporary stretching post about 3 feet deep and tamp down the earth solidly around it.





1 = Orchard
2 Garden and small fruits
3 House, barn, crib, machine shop, garage
4 Blue grass pasture
5 Garden
6 Tenant house



1, 2, 3, 4 = Temporary hog feeding lots
5 Orchard
6 House, garden, poultry yard, etc.
7 Barn, crib, pasture lot, etc.

Fig. 14. Field Layouts Showing Differences in Fence Requirements on Two 160-acre Corn Belt Farms. Scale is 40 rods to the inch. (From U. S. D. A. Bul. 1463.) (Farm A on left; B on right.)

*Work Book in Farm Management—Case, Ross & Green.

Problems for Work, Study and Discussion

1. What is the effect of shape of field upon the amount of fencing required? Ascertain the amount of fence required for each of the following enclosures.

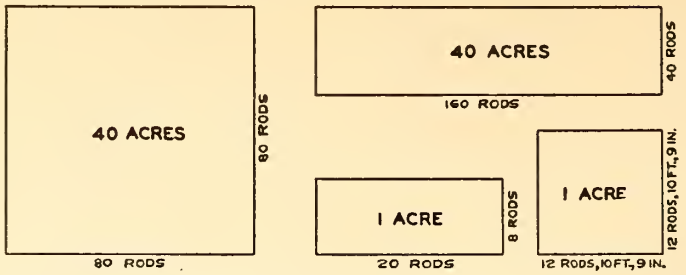


Fig. 13. Diagram Showing Effect of Shape of Fields on Amount of Fence Required.*

Amount of fence for field A.....Amount of fence for field C.....

Amount of fence for field B.....Amount of fence for field D.....

Difference..... Difference.....

2. What is the effect of size and shape of fields upon the cost of fencing farms of the same number of acres? Below are field layouts of two successful 160-acre corn-belt farms (From U. S. D. A. Bul. 1463). Find the total amount of fence required for each farm. Count only one-half the distance of all division line fences. Use $1.00 as the average value per rod of woven wire fence on each farm, and 50 cents per rod for barb wire fence. Find the value of fence on each farm.

	Farm A	Farm B
Acres		
Rods of fence		
Total value		

3. What is the cost of constructing fences of different materials?
   (a) Figure cost of construction for a three-barbed wire fence 80 rods long with posts a rod apart with bracing constructed at each 40 rods. Secure costs of material at local store. Estimate amount of labor required. Use local wage rate.
   (b) Repeat, using 30-inch woven wire.

Barbed Wire		**30-Inch Woven Wire**	
Items	Cost	Items	Cost
Labor		Labor	
Materials		Materials	
	Total		Total

*Work Book in Farm Management. Case, Ross and Green.

HANDLING BOSTROM LEVEL

Job Specification

To test and adjust the Bostrom Level.

Procedure

Setting Up the Level

1. Set the level up, placing the legs approximately three feet apart. Push the legs into the ground firmly.
2. Tighten the leg screws.
3. Place the bubble tube over two thumb screws. Adjust the screws to make the bubble tube come to center as shown in Fig. 2.
4. Turn turret 90 degrees and level up, using only the third screw. Fig. 4.
5. Repeat steps 3 and 4 one or more times, or until it is found that the bubble tube stands between vial lines as shown in Fig. 1, when the turret is turned in any horizontal position.

Swing the turret 180 degrees as shown in Fig. 3. If the bubble remains in the center, it is in proper

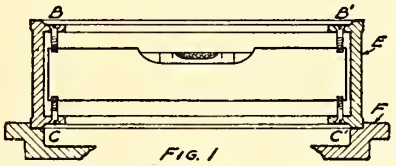


FIG. 1

adjustment. If it does not, then lower the high end of the vial so that the bubble will move back one-

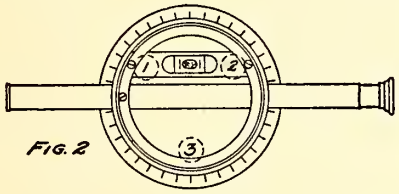


FIG. 2

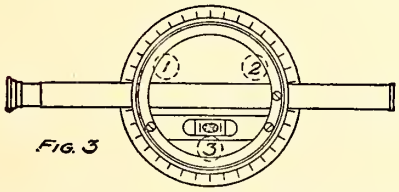


FIG. 3

half the distance it is away from the center. If it is away ¼" then move it back ⅛". (It will be necessary to remove the three screws, or loosen the clamps that hold the turret on before making any adjustments.)

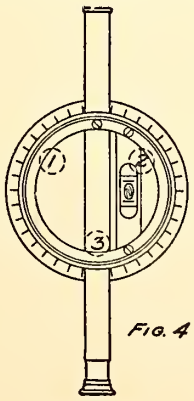


FIG. 4

6. After adjustment has been made, repeat the testing operation. It will be necessary to make this adjustment several times before getting the bubble tube properly adjusted.

To Focus the Telescope

1. Point the telescope towards the target at working distance.
2. Place the hand on top of the turret so as to hold it down firmly, then get the focus by moving the eyepiece out and in until the target is clear.

Adjusting Cross-Hairs for Horizontal Position

1. Set the level up.
2. Place the rod some three or four hundred feet away. Set the intersection of the target on one end of the horizontal cross-hair and then move the telescope until the target appears at the opposite end of the horizontal cross-hair.

If the horizontal cross-hair still coincides with the center of the target it is in proper adjustment.

3. To make proper adjustment, remove the eyepiece and turn the lens to the right (do not turn backwards).

Note: It is seldom that this adjustment needs to be made, and for that reason the cross-hairs should not be bothered unless they are out of horizontal position.

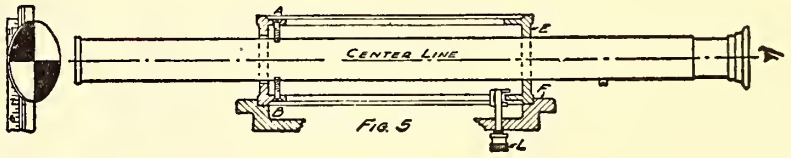


FIG. 5

Testing and Adjusting the Line of Sight

1. Check to see that the telescope is not loose in the turret.
2. Sight at some definite point that will be easily relocated some several hundred feet away.
3. Invert the turret.
4. If the intersection of the cross-hairs coincides with the original point, then the line of sight is in proper adjustment. If the line of sight is below the original point sighted, after the instrument has been inverted, then the line of sight is too high when the level is in use.

If the line of sight is above the original point, after the turret has been inverted, then the instrument is shooting too low when in use.

5. To make the proper adjustments in the first case, or to lower the line of sight, loosen the top screw in the telescope and tighten the bottom one.

Caution: Be sure that both screws in the telescope are tight before testing to see if the proper adjustments have been made.

6. To raise the line of sight, loosen the lower screw in the telescope and tighten the top one.

7. After each adjustment has been made it will be necessary to sight on a new object to make another test.

8. Plenty of time should always be taken to test the level and make the adjustments.

Care of the Level

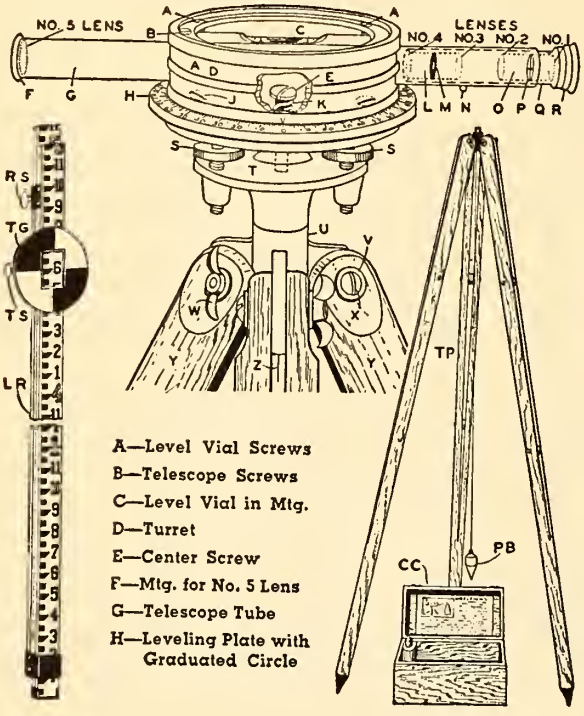
1. Take care not to drop the level.

2. Set the level up so it will not be easily knocked or blown over.

3. Care should be exercised not to touch legs of the level after it has been set up.

4. A small amount of light oil or graphite applied to the underside of the turret will aid in moving the telescope.

5. Always test the level before using it.



J—Plate Screws
K—Center Spring
L—No. 2 Tube
M—Light Diaphragm
N—Slide Screw
O—No. 1 Tube
P—Cross Hairs
Q—Slide Tube
R—Eye Cap
S—Leveling Screws
T—Leveling Head
U—Tripod Head
V—Washers
W—Wing Nuts
X—Leg Bolts
Y—Tripod Legs
X—Plumb Bob String
Lenses—Nos. 1, 2, 3, 4, 5
RS—Rod Screw
TG—Target
TS—Target Screw
LR—Leveling Rod
TP—Tripod
CC—Carrying Case
PB—Plumb Bob

Questions on Terracing

1. How many acres of land do you have on your farm that are already terraced?.....

2. How many acres of land do you have on your home farm that need to be terraced?.....

.....

3. List the equipment that you have available for the construction of terraces.....

.....

4. Is there any county owned equipment available in your county for the construction of terraces?

.....

5. About how much do they charge per hour for this machinery?.....

6. What are the factors that determine whether or not it would pay to terrace your own farm?

.....

.....

.....

7. What would be the best time of the year to terrace?.....

8. Explain how a terrace might increase the yield on a piece of land.....

.....

.....

.....

.....

9. Explain how to run a level terrace line.....

.....

.....

.....

.....

.....

.....

10. Explain how to run a uniform graded line.....

.....

.....

.....

.....

.....

.....

11. Explain how to run a variable graded line.....

.....

.....

.....

.....

.....

12. What type of terrace do you think would be best in your community?.....

.....

13. Draw a sketch showing the cross section of a terrace that would be suitable for your community.

14. What are some advantages of a wide terrace?

.....

.....

.....

15. What should be the average height of a good terrace?.....

16. What are the principal causes of terraces breaking?.....

.....

.....

.....

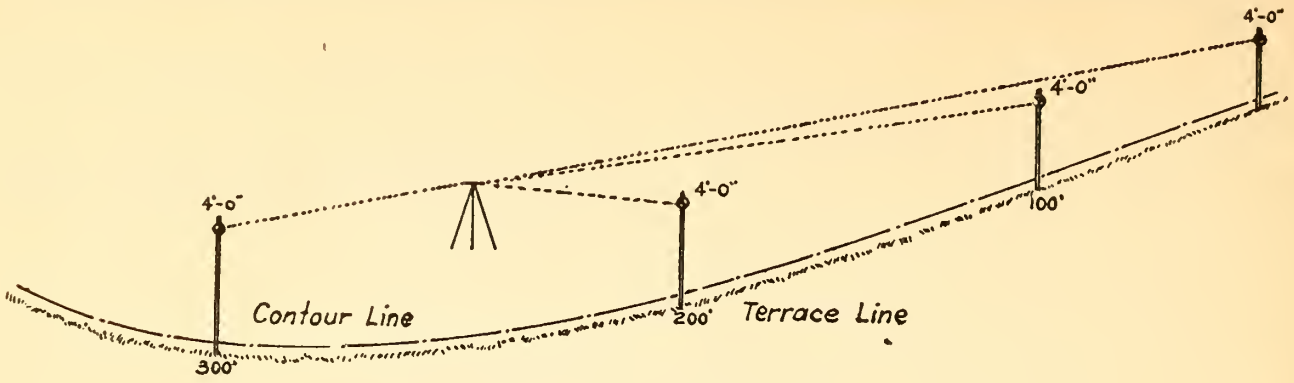
17. What do you consider the maximum length of a terrace?.....

18. Name some of the different machines that may be used in building terraces. .....

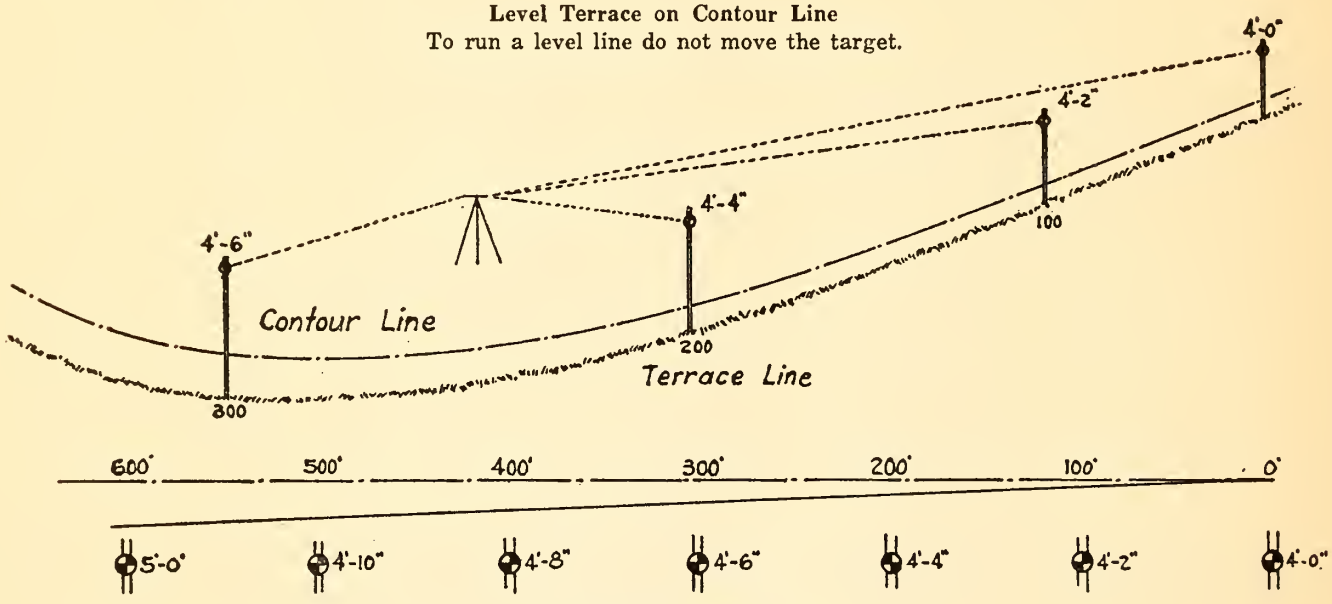
.....

.....

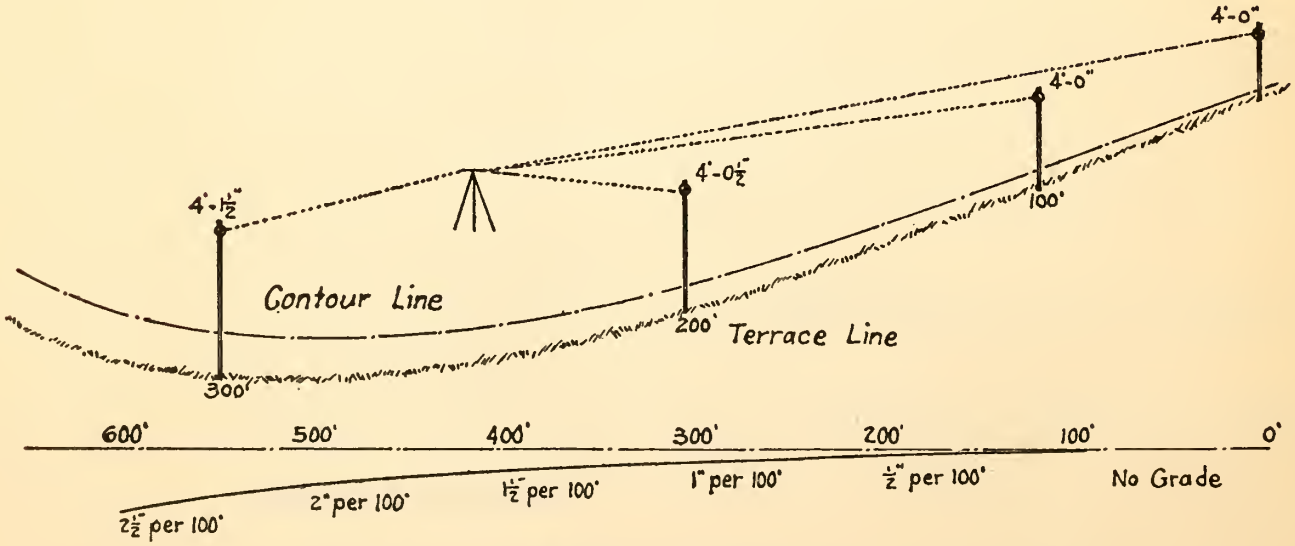
ILLUSTRATIONS SHOWING HOW TO RUN DIFFERENT KINDS OF TERRACE LINES



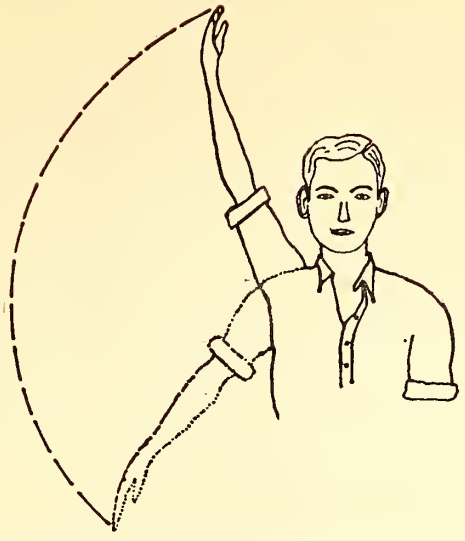
Level Terrace on Contour Line
To run a level line do not move the target.



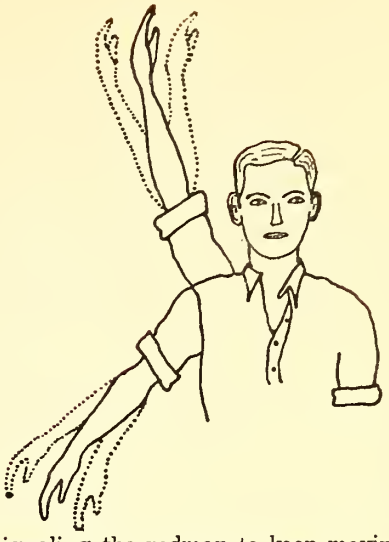
Uniform Graded Terrace
To run a uniform graded line the target is moved the same distance at each station.



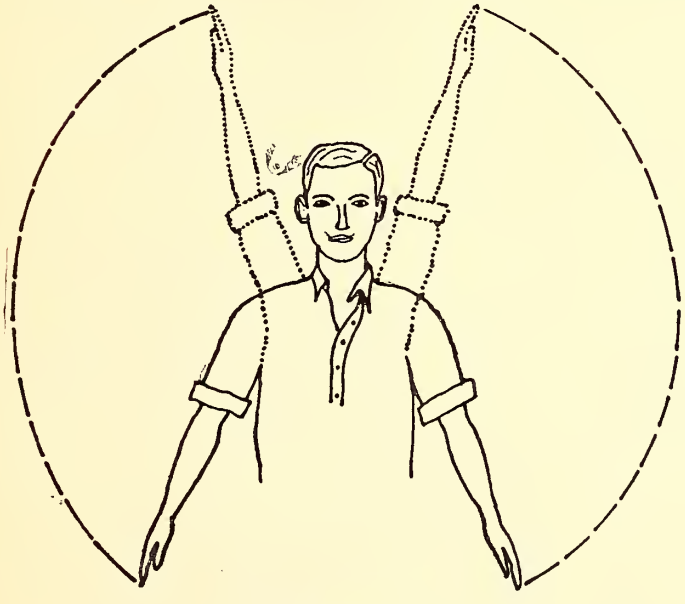
Variable Graded Terrace
To run a variable graded line it is necessary to move the target differently at each station.



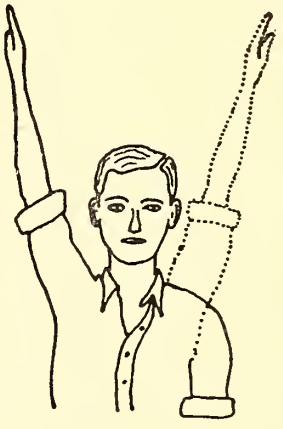
Signaling the rodman to move up or down the hill.



Signaling the rodman to keep moving up or down the hill.

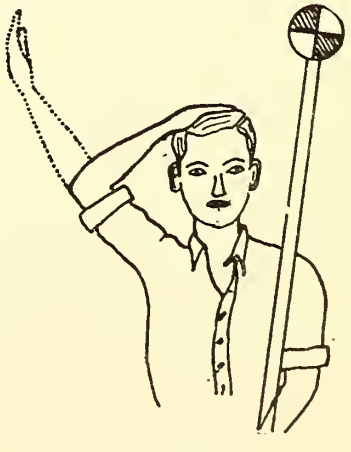


"All Right."



Signaling rodman to plumb the rod.

Signaling the rodman to move the target up or down.



The rodman signaling that he has moved the target.
(This signal should be given by the rodman each time before he moves, except when running level terrace lines.)

OUTLINE OF A FARM ENGINEERING COURSE FOR HIGH SCHOOLS

I. Tools
- Theory
  1. The history and development of different kinds of tools
  2. The different kinds of tools
  3. The uses of tools
- Demonstrations
  1. Demonstration in sharpening different kinds of tools
  2. Cleaning and oiling tools
  3. The correct use of each tool
- Jobs
  1. School jobs
     (a) Sharpen farm shop tools
     (b) Clean and oil all farm shop tools.
     (c) Replace all broken handles—shop tools
  2. Home jobs
     (a) Collect all home farm tools
     (b) Clean and oil all home farm tools
     (c) Sharpen and recondition all home tools, such as axes, wood saws and chisels

II. Woodwork
- Theory
  1. Kinds, uses and grades of lumber on the farm
- Demonstrations
  1. Squaring a piece of lumber
  2. How to plane
  3. How to saw a piece of lumber
- Jobs
  1. School jobs
     (a) Build work benches for shop or tables for class room
     (b) Feeders and troughs for Group Project
     (c) Construct a hot bed frame
     (d) Book and magazine racks
     (e) Boxes to file bulletins
  2. Home jobs
     (a) Study table
     (b) Book racks
     (c) Tool cabinet
     (d) Budding knives
     (e) Feed troughs

III. Bills of Material
- Theory
  1. Methods to use in figuring bills of material
  2. How to read a blue print or a work plan
- Demonstrations
  1. Demonstrations in figuring the number of board feet in a 2″ x 4″ x 16′
  2. Have a poultry self-feeder before the boys and figure the number of board feet in the feeder. The number of pieces of each kind of lumber needed to construct the feeder
- Jobs
  1. School jobs
     (a) Figuring bills of material for feeders to be used in a group project
     (b) Figuring bills of material for shop work benches and classroom tables
     (c) Make a work plan of a brooder house, hog self-feeder, etc
  2. Home jobs
     (a) Figuring bills of material for a study table
     (b) Figuring bills of material for a farm gate
     (c) Figuring bills of material for a tool cabinet
     (d) Figuring bills of material for a hog self-feeder

IV. Roof Framing
- Theory
  1. Types of roofs
  2. The different pitches of roofs
  3. Methods of cutting rafters
- Demonstrations
  1. Demonstration of marking and cutting
     (a) A gable roof
     (b) A shed roof
     (c) A jack rafter
     (d) A hip rafter
- Jobs
  1. School jobs
     (a) Frame a brooder house
     (b) Frame a bus shed
  2. Home jobs
     (a) Frame a poultry shed roof house
     (b) Frame an "A" type hog house
     (c) Frame a farm machinery storage shed

V. Rope Work
- Theory
  1. Machine to use
  2. Materials
     (a) Binding twine (sisal)
     (b) Manila
  3. Uses of rope
     (a) Plow lines
     (b) Various knots and hitches
     (c) Splices
  4. Finishing
     (a) Crowning ends
     (b) Whipping ends
  5. Cost
     (a) 10c to 12c per pound
- Demonstrations
  1. Making rope of various sizes
  2. Tying knots useful on farm
  3. Finishing
     (a) Splicing
     (b) Crowning
     (c) Whipping
- Jobs
  1. Make rope and rope articles

VI. Leather Work
Theory
1. Tanning leather
(a) Chrome tanning
1. Cowhide for harness leather.
2. Calf hides, goat and deer skins for thong and lacing work.
(b) Bark tanning (red oak)
1. Cow hides for harness leather; sole leather
2. Calf hides, goat, deer skins for thong and lacing work
2. Care of leather
(a) Oils and oiling
(b) Repairs: shoes and harness
3. Making leather goods
(a) Leather craft
1. Reference—Lester Griswold
2. Leather thong cutting
(a) Plaiting
(b) Art work
(b) Harness making
1. Sewing and riveting
2. Hame straps, lines, etc
Demonstrations
1. Making sewing thread
2. Use of awl
(a) Sew wagon lines
3. Thong cutting
(a) Plaiting
1. Four plait
2. Six plait
4. Mix tanning solution
5. Demonstrate
(a) Taking hair off
(b) Fleshing
(c) Skiving
Jobs
1. School
(a) Tanning
1. One cow hide
2. One calf hide
3. Make lace leather
2. Home
(a) Repair harness
(b) Repair saddle
(c) Make halter
(d) Make wagon lines

VII. Forging
Theory
1. Materials and equipment
(a) Tool steel, mild steel, cast iron.
(b) Forge, tongs, hammer, water, coal
2. Heating
(a) Deep yellow
(b) Proper heats for different welds
3. Tempering and annealing
(a) Colors
1. Blue, black, blue and purple
Demonstrations
1. Making and tempering
(a) Center punch
(b) Chisel
(c) Clevis
(d) Hay hook
Jobs
1. School
(a) Make punch, chisel, clevis
2. Home
(a) Make gate hook
(b) Make hay hook
(c) Make hinges

VIII. Soldering
Theory
1. Equipment, fluxes, solder and methods
2. References: Cornell Bul. No. 57, Farm Shop, Book 1
Demonstration
1. Tinning a soldering copper
2. The correct use of copper
3. Correct uses of fluxes
Jobs
1. School
(a) Funnel
(b) Nail box
2. Home
(a) Repair bucket
(b) Feed scoop
(c) Chicken trough

IX. Paints and Painting
Theory
1. Equipment, types of paint jobs
2. Kind of paints
3. Condition of surface for paint
4. Number of coats
Demonstrations
1. Correct method of mixing paint
2. Correct method of cleaning brushes
3. Correct method of applying paints, varnish, stains and whitewash
4. Different ways of finishing
Jobs
1. School
(a) Stain and varnish book rack
(b) Paint tool carrier
2. Home
(a) Paint feeder
(b) Stain and varnish picture frame

X. Concrete
Theory
1. Farm uses
2. Equipment
3. Mixing
4. Placing
5. Curing
6. References job sheet
Demonstrations
1. Correct ways of mixing concrete
2. Placing materials
3. Properly finishing concrete.
Jobs
1. School
(a) Estimating, proportioning, mixing and placing materials
(b) Concrete slab
(c) Tile

2. Home
   (a) Hog trough
   (b) Side walk
   (c) Bench

XI. Farm buildings

Theory
1. Value of buildings suited to the farm program
2. Cost of usual farm buildings

Demonstration
1. Inspection trip to see milk shed, potato house, etc.

Jobs
1. School
   (a) Build a potato house
   (b) Build a smoke house
2. Home
   (a) Potato curing and storing house
   (b) Storm cellar
   (c) Poultry houses
   (d) Home canning house
   (e) Implement shed
   (f) Smoke house
   (g) A type of hog house

XII. Farm surveying

Theory
1. Need of knowing size of farm and fields
2. Units of measurements

Demonstration
1. Measuring a field and figuring acreage

Jobs
1. School
   (a) Figure acreage of school ground and football field
2. Survey home farm and post plan in notebook
3. Survey of individual fields on home farm

XIII. Soil Conservation

Theory
1. Amount of soil loss in U. S.
2. Effect of the loss of soil
3. Methods of preventing soil erosion
   (a) Terracing
   (b) Contouring
   (c) Strip cropping
   (d) Soil saving dams
4. Crop yields as related to terraced and unterraced lands

Demonstration
1. Setting up and adjusting level.
2. Testing level
3. Terracing one farm
4. Building a permanent outlet

Jobs
1. School
   (a) Check old system of terraces
2. Home
   (a) Terrace the home farm
   (b) Control ditches by vegetative matter and dams
   (c) Making permanent outlets
   (d) Contouring pasture

XIV. Home Convenience

Theory
1. Labor saving value of home conveniences
2. Study the conveniences used in the modern farm home
3. Study of the conveniences that are practical for our homes.

Demonstration
1. Visit an up-to-date farm home to observe the conveniences
2. Study plans for several simple home conveniences
3. Arrangements of household fixtures and furniture

Jobs
1. School
   (a) Improve the water system
   (b) Book cases for school room
   (c) Dictionary stand
2. Home
   (a) Study desk
   (b) Milk maids gate, etc.
   (c) Ironing board
   (d) Canned goods pantry
   (e) Milk stool
   (f) Septic tank
   (g) Pit type toilet

XV. Farm Plumbing

Theory
1. Tools needed
2. Care of tools
3. Value of farm plumbing
4. Pipe and pipe sizes
5. Kind of pipe fittings and their use

Demonstrations
1. Measuring of pipe
2. Cutting pipe
3. Threading pipe
4. Making leak-proof joints

Jobs
1. School
   (a) Practice measuring and fitting pipe
   (b) Practice threading pipe
   (c) Practice cutting pipe
2. Home
   (a) Piping water into the house
   (b) Fitting in and installing drain pipe from kitchen sink or the bathtub
   (c) Making repairs on the home piping
   (d) Installing hydrants in the lots, gardens, yards

XVI. Repair and Care of Farm Machinery

Theory
1. Methods of caring for machinery
2. Value of housing machinery

3. Depreciation of machinery and how to prevent excess depreciation
4. Study of types of farm machinery, which parts wear and need most attention
5. Uses of various farm implements found in community

Demonstrations

1. Using some worn and used farm implement such as a planter and completely overhaul, paint, oil and grease

Jobs

1. School
   (a) Overhauling a cultivator
   (b) Practice painting farm machinery
   (c) Overhauling terracing machine
2. Home
   (a) Storing machinery
   (b) Installing new parts
   (c) Tightening up where worn
   (d) Overhauling bearings
   (e) Oiling and greasing
   (f) Painting and setting machinery for best work
   (h) Sharpening plows and other farm implements as mowers, etc.
   (i) Making and installing tongues in wagons, etc.
   (j) Making and installing coupling poles
   (k) Overhauling and tightening up wagon wheels
   (l) Pulling pumps and installing new valves and leathers and pump rods
   (m) Installing new parts, greasing and care of the windmill
   (n) Rebabbiting bearings

XVII. Landscaping

Theory

1. The value of landscaping the home yards
2. Methods and implements to use
3. Studying good examples of landscaping

Demonstrations

1. Setting trees and shrubs

Jobs

1. School
   (a) Designing and making the plans for the home landscaping job (diagrams and drawings)
   (b) Practice by landscaping the school grounds
2. Home
   (a) Measuring, lining off, filling in and leveling the home yard
   (b) Surveying for the walks
   (c) Planning and setting the trees, shrubs, grass and flowers
   (d) Putting up trellis

A MINIMUM RECOMMENDED LIST OF TOOLS FOR A CLASS IN VOCATIONAL AGRICULTURE OF 20 BOYS

Wood Working

10 Cross cut saws
4 8-point 24″
3 9-point 24″
1 10-point 24″

2 Rip Saw
7-point 24″

1 Nest of saws
Handle and 4 blades

2 Adze eye bell face 16 oz. hammers.
10 Adze eye bell face 13 oz. hammers.
2 Adze eye bell face 10 oz. hammers.

1 Tack hammer

4 Framing squares—16″ by 24″

8 Try squares—8″

1 'T' bevel

1 Tape, metallic—50 Ft.

6 1-Yard rulers (Secured from Lumber yards)

6 Marking gauges

1 Carpenter's level—30″

1 Chalk line—100 Ft.

2 Draw knives

2 10″ braces

1 Set of Auger bits, ¼″ to 1″ by 16 ths.

1 Set of Auger bits, ¼″ to 1″ by 8 ths.

2 Sets of Twist drills for brace 1/8″ to 5/8″ by 16 ths.

1 Expansive bit—7/8″ to 3″

2 Hand drills with bits

1 Hand axe

1 Large Chopping axe

2 Sets of wood chisels—¼″: ½″: ¾″ and 1″

4 Rose counter sinks for wood

2 Wing dividers—8″

3 Sets of screw drivers—3 to the set. 6″, 8″, and 10″

4 Screw driver bits

4 Combination carborundum oil stones No. 108

4 Saw sets for hand saws

2 Saw clamps

2 Saw jointers

4 Wood mallets—3½″ by 5½″

1 Doz. 5½″ Slim taper saw files

6 10″ Mill files
1 6″ Round file
1 10″ Round file

4 Wood rasps half round—12″ (2 fine and 2 coarse)

8 Jack planes

2 Smoothing planes

1 Block plane

2 Hand scrapers—3½″ by 5″

1 Tool grinder (Power Preferred) 6 inch stone.

1 Steel miter and saw

6 Sets No. 500 Steel bar clamps
Fixtures for making pipe clamps

Approximate Cost.....$195.00

Metal Work

1 Machinist's vise—4″ jaw

1 Post drill

1 Set twist drills for post drill 1/8″ to 5/8″ by 16 ths.

1 Hack saw frame—adjustable Pistol grip preferred

12 Hack saw blades

6 Pair pliers

2 Blow torches

6 Soldering coppers—1 lb. to 2½ lbs.

1 Pipe vise

1 Set of stock and dies, for 3/8″ to 2″ pipe

2 Monkey wrenches—10″

1 Set stock and dies for bolts ¼″ to 5/8″ U.S.S.

1 Set socket wrenches

2 18″ Stilson pipe wrenches
1 12″ Stilson pipe wrench

2 Pair tin snips—3″ (straight lip)
1 Pair tin snips—3″ (curved lip)
(For Stove Pipe)

4 Cold chisels (Shop made)

2 Punches (Shop made)

4 Nail sets (Shop made)

1 ¾″ Star drill

2 Putty knives

2 Oil cans

1 Hand forge

1 Anvil—125 lbs, Steel face

2 Pair tongs—18″ straight lip

1 Pair tongs for holding bolts

2 Ball pein hammers—24 oz.
1 4 lb. sledge hammer

2 Crescent wrenches—6″ and 10″

1 Set N wrenches

Approximate Cost.....$100.00

Concrete Work

2 Shovels, square point—No. 2

1 Trowel

1 Edger

1 Groover

1 Wood float (shop made)

2 1-cu. ft. boxes (shop made)

2 1-10 cu. ft. boxes (shop made)

2 Screens, for aggregates (shop made)

Approximate Cost.....$7.50

Harness and Leather Work

6 Awls

24 Harness needles, No. 2

1 Pricking wheel, 8 point

1 Riveting machine for hollow rivets

1 Spring punch—4 tubes

1 lb. Harness wax

6 Balls No. 10 Linen thread

2 Leather knives

1 Gauge knife

2 Edgers

2 Groovers

6 Harness stitching clamps (shop made)

1 Set of Leather dies (shop made)

1 Rope machine (shop made)

1 First aid cabinet

Wherever electric power is available, it is strongly recommended that the following machine equipment be provided and purchased in the order listed.

		Approximate Cost
1	6″ Power Grinder	$25.00
1	8″ Bench saw, with dado head and motor	45.00
1	Jig Saw—24″ with motor	45.00
1	Power sander and motor	40.00
1	36″ Wood lathe and motor, with tools and attachments	50.00
1	6″ Jointer and motor	50.00
1	16″ Band Saw with motor	50.00
1	Drill press and motor	40.00

REFERENCES ON FARM SHOP

(Recommended for Teaching Vocational Agriculture)

The Farm Shop

Farm Shop and Tool Equipment,
Cornell Extension Bul. 108, Ithaca, N. Y.
Small General Shop, Bul. 50,
South Bend Lathe Works, South Bend, Ind.
Farm Shop Bulletin, 147,
Agr'l Experiment Station, Pullman, Wash.
Farm and Home Mechanics, (10c)
Office of Indian Affairs, Washington, D. C.
Blue Prints of a Combination Shop and Class for Students—Agricultural Engineering Department, College Sta., Texas (50c)
List of tools for the Home Shop,
M. F. Thurmond, College Station, Texas.
List of Tools for a Class of 20,
M. F. Thurmond, College Station, Texas.
Blue Prints of Shop Equipment & Shop Jobs,
Bell Saw Mfg. Co., 210 West 8th St., Kansas City, Mo.
The Farm Shop, Smith,
State College of Washington, Pullman, Wash.
The Farm Shop, Graham & Shed,
Bulletin 22, Kansas Agr. College, Manhattan.
The Farm Shop & School Shop for Vocational Agriculture, Kansas State College, Manhattan, Kansas.

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Sharpening Hand Woodworking Tools, Coggin, Giles & Armstrong, The Interstate, Printers & Publishers, Danville, Ill. (1939)
Shop Work for Farm Boys, Thurmond, Interstate, Danville, Ill.
Job Operations in Farm Mechanics, Dickinson, The Interstate, Danville, Ill. (1936)
Farm Mechanics Text & Handbook, Cook, Scranton & McColly, Interstate, Danville, Illinois. (1939)
Practical Methods in Teaching Farm Mechanics, Cook & Walker, Interstate Printers & Publishers, Danville, Illinois. (1936)
Agricultural Mechanics, Smith,
Lippincott Company, Philadelphia, Pa. (1925)
Construction and Repair Work on the Farm,
Struck, Houghton Mifflin Company, Boston, Mass. (1923)
Farm Enterprise Mechanics, edited by J. B. Davis, Lippincott Company, Philadelphia, Pa. (1935)
Farm Machinery, Robb and Behrends,
John Wiley & Sons, New York. (1923)
Farm Mechanics, Field,
Olson & Nylin, John Wiley & Sons, New York. (1938)
Farm Mechanics, Crawshaw & Lehmann,
Manual Arts Press, Peoria, Ill. (1922)
Farm Motors, Potter,
McGraw-Hill Book Company, New York. (1926)
Farmers' Shop Book, Roehl,
Bruce Publishing Company, Milwaukee, Wis. (1924)
Operation, Care and Repair of Farm Machinery,
John Deere & Co., Moline, Ill. (Free)
Principles of Farm Mechanics, Sharp & Sharp,
John Wiley & Sons, New York, N. Y. (1930)
Shop Management in Rural High Schools, Roehl,
Bruce Publishing Co., Milwaukee, Wis. (1934)
Teaching Farm Shop Work & Farm Mechanics,
Schmidt, Ross & Sharp, The Century Company. (1927)
Farm Gas Engines, F. R. Jones, McGraw-Hill Publishing Company, New York, N. Y.
Farm Machinery, H. P. Smith, McGraw-Hill Publishing Company, New York, N. Y.
Agricultural Machinery, Davidson,
John Wiley & Sons, New York, N. Y.
Free Illustrative Material for Courses in Vocational Agriculture, Henderson, Interstate Printers & Publishers, Danville, Ill. (free)
General Shop Wood Working, Fryklund & Berge, McKnight Publishing Co., Bloomington, Ill.
General Shop Handbook, Wiloughby & Chamberlaine, Manual Arts Press, Peoria, Ill.
Instruction and Information Units for Hand Wood Working, Douglas & Roberts, McCormick Mathers Co., Wichita, Kansas.
Modern Projects in Woodwork, Douglas & Roberts, McCormick & Mathers Co., Wichita, Kan.
Handbook on Rural Electrification, P. T. Monfort, College Station, Texas.

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Rope Work

Knotting and Splicing Ropes and Cordage,
Cassell & Company, New York.
Farmers' Bulletin 667, V. G. Stambough, Cornell University, Ithaca, N. Y.
Knots, Hitches & Splices, H. W. Riley,
Bulletin 13, Cornell Univ., Ithaca, N. Y.
Rope and Its Use on the Farm, Ohio Agr. Bul. 82, Columbus, Ohio.
Tying Knots and Splicing Rope, Bulletin 13, Cornell University, Ithaca, N. Y.
Rope and Its Uses, Bulletin 34
Iowa State College, Ames, Iowa.
Rope and Its Uses, Circular 44
State College, Fargo, North Dakota.
The Use of Rope on the Farm, Circular 700
Nebraska Extension Service, Lincoln.
Manila Twine may be purchased through your nearest International Harvester dealer. Specifications: "Superior Manila Twine" 650 feet to a pound, breaking strength, 110 lbs.

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Soldering

Soldering, Extension Service Bulletin 57
N. Y. State College of Agr., Ithaca, N. Y.
Facts on Soldering
The Kester Solder Company, Chicago, Ill.

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Leather Work

Harness Repairing, Bulletin 150
Cornell University, Ithaca, N. Y.
Country Hides and Skins, Farmers' Bul. 1055, Washington, D. C.
Home Tanning, Farmers' Bulletin 1334
U. S. D. A., Washington, D. C.

The Care of Leather, Farmers' Bulletin 1183
U. S. D. A., Washington, D. C.
Tanning Hides, Extension Service,
College Station, Texas.
Making a Halter, Extension Service,
College Station, Texas.
Making a Bridle, Extension Service,
College Station, Texas.
Handicraft in Leather, (10c)
Lester Griswold, Colorado Springs, Colo.

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Care and Use of Saws

How to Care for and Use Cross Cut and Hand Saws,
E. C. Atkins Company, Memphis, Tenn.
Saw Sense,
E. C. Atkins Company, Memphis, Tenn.
The Saw in History,
Henry Diston & Sons, Inc., Philadelphia, Pa.
The File in History,
Henry Diston & Sons, Inc., Philadelphia, Pa.
The Diston Saw Tool and File Book,
Henry Diston & Sons, Inc., Philadelphia, Pa.
The Pruning Book,
Henry Diston & Sons, Inc., Philadelphia, Pa.
Simonds Files,
Simonds Manufacturing Company, Chicago, Ill.

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Rural Electrification

The Farm Wiring Problem,
General Electric Company, Bridgeport, Conn.
Information on Rural Electrification,
Committee on the Relation of Electricity to Agriculture, 1120 Garland Building, Chicago, Ill.
One Hundred and One Uses of Electricity,
Texas Power and Light Company, Dallas, Tex.
Electric Fences, The Prime Manufacturing Company, Milwaukee, Wisconsin.
General Information on Rural Electrification,
P. T. Montfort, College Station, Texas.

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Extension Service, College Station, Texas.

Name	Serial Number
Poultry House Plans	62
Self Feeder for Hogs	109
Home Made V Drag	92
Hog Scalding Vat	188
Meat Curing Ice Box	203
Pit Privy	164
Septic Tank	78

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Containing Information on Home-Made Eqpt.
Poultry Yard Equipment, Bulletin 71
Texas A. & M. College, College Station, Tex.
Growing Baby Chicks, Bulletin 83
Extension Service, College Station, Texas.
Marketing Eggs, Farmers' Bulletin 1378
U. S. D. A., Washington, D. C.
Poultry Houses for Texas, Bulletin 65,
Extension Service, College Station, Texas.
Construction & Packing of an Egg Case,
U. S. D. A., Leaflet 64, Washington, D. C.
Containers Used in Shipping Fruits,
Bulletin 1579, U. S. D. A., Washington, D. C.
Home Storage of Vegetables, Bulletin 879,
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Drying Vegetables and Fruits for Home Use,
Circular, U. S. D. A., Washington, D. C.
Rabbit House Construction, Leaflet 15,
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A. & M. College, College Station, Texas.
A Drying Plant, Bulletin 916,
U. S. D. A., Washington, D. C.
Feeding Beef Calves, Bulletin 378,
A. & M. College of Texas, College Station, Tex.
Equipment for Sheep Raising, Farmers' Bul. 810,
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Hog Lot Equipment for Texas, Bulletin 81,
Experiment Station, College Station, Texas.
Dairy Barn Plans, Extension Bulletin 59,
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College Station, Texas.
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Farmers' Bulletin 1192, U. S. D. A., Wash.
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U. S. D. A., Washington, D. C.
The Use of Logs and Poles in Farm Construction,
Farmers' Bul. 1660, U. S. D. A., Washington.
Sub-Irrigation for Gardens, Extension Bul. 97,
A. & M. College of Texas, College Station, Tex.
Terracing Farm Lands in Texas,
Extension Bulletin 51, College Station, Tex.
Gully Control, Extension Bulletin 80,
College Station, Texas.
Farm Work Shop and Woodlands,
E. C. Atkins & Co., Indianapolis, Indiana.
Grinding Farm Tools, Bulletin 155,
Cornell Extension Ser., Ithaca, New York.
A Hundred Handy Helps,
Southern Pine Assn., New Orleans, La.
Making Things, First Year and Second Year,
International Harvester Co., Chicago, Ill.
Fitting the Farm Saws,
Extension Serv., Cornell Univ., Ithaca, N. Y.
How to Sharpen Woodworking Tools,
Carborundum Co., Niagara Falls, New York.
Convenient Kitchens, Bulletin 1513,
U. S. D. A., Washington, D. C.
Farm Home Conveniences, Farmers Bul. 927,
U. S. D. A., Washington, D. C.
Preservative Treatment of Farm Timbers
Nat'l Lumberman's Assn., Chicago, Ill.
Farm Water Supply, Bulletin 50,
Cornell University, Ithaca, New York.
Farmstead Water Supply, Farmers' Bul. 1448,
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Whitewash and Cold Water Paint, Bulletin 304V,
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Farm Plumbing Farmers' Bul. 1426,
U. S. D. A., Washington, D. C.
Wood Preserving News,
Service Bureau, Am. Wood Preservers, Chicago.
Concrete Around the Home,
Portland Cement Assn., Austin, Texas.
Concrete Tanks, Troughs and Cisterns,
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101 Uses of Concrete on the Farm,
Portland Cement Assn., Austin, Texas.
Rafter Cutting,
Sargent & Company, New Haven, Conn.
Rafter and Framing,
Stanley Tool & Level Co., New Britian, Conn.
Making Useful Things,
Masonite Corporation, Chicago, Ill.

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E. C. Atkins & Co., Indianapolis, Ind.
Short Cuts to Power Transmission, Flexible Steel Lacing Co., 4607 Lexington, Chicago, Ill.
More Jobs From the Same Rope,
Hooven & Allison Co., Xenia, Ohio.
Water and Plumbing System for Farm Home,
Circular 303, Illinois Extension Ser., Urbana, Ill.
How to Get the Most From Your Tractor,
International Harvester Co., Chicago, Ill.
The McCormick-Deering Gas Engine Handbook,
International Harvester Co., Chicago, Ill.
Life Service and Cost Service of Machinery,
Bulletin 92, Iowa State College, Ames, Iowa.
Wind Electric Plants, Bulletin 297,
Iowa State College, Ames, Iowa.
Electric Motors for the Farm, Extension Bul. 69,
Kansas State College, Manhattan, Kansas.
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Storing Soft Water for the Farm Home,
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Kansas State College, Manhattan, Kansas.
Cobblestone Construction for Farm Buildings,
Circular 297, Columbia, Missouri.
Home-Made Labor-Saving Devices for the Hog Farm, Circular 131, Columbia, Missouri.
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Missouri Extension Service, Columbia, Mo.
Tractor Hitches, Bulletin 229,
Montana Exp. Station, Bozeman, Montana.
The Handbook on Painting,
National Lead Company, Chicago, Ill.
Water Supply and Sewage Disposal Systems for Farm Homes, Bulletin 245, Nebraska Extension Service, Lincoln, Nebraska.
File Filosophy,
Nicholson File Company, Providence, R. I.
Distillate as a Tractor Fuel, Circular 94,
North Dakota Publications Dept., State College, Fargo, N. D.
Sewage Disposal for North Dakota Farm Homes,
Circular 103, Fargo, N. D.
Silage and Trench Silo, Circular 63,
Fargo, North Dakota.
Testing Gravel for Farm Concrete Construction,
Circular 129, Fargo, North Dakota.
The Combined Harvester-Thresher in North Dakota,
State College, Fargo, North Dakota.
The Ice-Well Refrigerator,
Ag. Engineering Mimeograph Leaflet, North Dakota Publications Dept., State College, Fargo, North Dakota.
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Bulletin 87, Ohio Univ., Columbus, Ohio.
Concrete Fence Posts,
Portland Cement Assn., Austin, Texas.
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U. S. Dept. of Commerce, Supt. of Documents, Washington, D. C.
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* * * * *

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TABLES OF WEIGHTS AND MEASURES

Troy Weight

24 grains = 1 pennyweight
20 pennyweights = 1 ounce
12 ounces = 1 pound

Apothecaries' Weight

20 grains = 1 scruple
3 scruples = 1 dram
8 drams = 1 ounce
12 ounces = 1 pound

The ounce and the pound in this system are the same as in troy weight.

Square Measure

144 square inches = 1 square foot
9 square feet = 1 square yard
30¼ square yards = 1 square rod
40 square rods = 1 rood
4 roods = 1 acre
640 acres = 1 square mile

Dry Measure

2 pints = 1 quart
8 quarts = 1 peck
4 pecks = 1 bushel
36 bushels = 1 chaldron

Liquid Measure

4 gills = 1 pint
16 fluid ounces = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
31½ gallons = 1 barrel
2 barrels = 1 hogshead

Long Measure

12 inches = 1 foot
3 feet = 1 yard
5½ yards = 1 rod
40 rods = 1 furlong
8 furlongs = 1 standard mile
3 miles = 1 league

Avoirdupois Weight

27-11/32 grains = 1 dram
16 drams = 1 ounce
16 ounces = 1 pound
25 pounds = 1 quarter
4 quarters = 1 hundredweight
2,000 pounds = 1 short ton
2,240 pounds = 1 long ton

Surveyor's Measure

7.92 inches = 1 link
25 links = 1 rod
4 rods = 1 chain
10 square chains or 160 square rods = 1 acre
640 acres = 1 square mile
36 sq. miles (6 miles square) = 1 township

Cubic Measure

1,728 cubic inches = 1 cubic foot
27 cubic feet = 1 cubic yard
2,150.42 cu. inches = 1 standard bu.
231 cu. inches = 1 standard gallon (liquid)
1 cu. foot = 4/5 of a bushel
128 cu. feet = 1 cord (wood)
40 cu. feet = 1 ton (shipping)

Approximate Number of Board Feet of Lumber Trees Containing One, Two, or Three 16-foot Merchantable Logs

8	19	32	
9	27	43	
10	36	57	64
11	46	73	84
12	58	90	108
13	68	110	131
14	80	130	160
15	92	154	192
16	160	181	226
17	120	208	260
18	136	234	305
19	150	263	350
20	169	300	396
21	180	335	440
22	204	365	485
23	225	395	530
24	246	430	580

This table was made primarily for use on Southern pine trees, but it may be used in estimating the board foot content of straight trunks and limbs of other kinds of trees.

Nails Required per M Feet of:

Shingles	3½ to 5 lbs. of 4d
Laths	6½ lbs. of 3d
Clapboard	18 lbs. of 6d
Boarding	20 lbs. of 8d
Studding	3 lbs. of 8d
Furring	45 lbs. of 8d
Inside Finish	30 lbs. of 8d
Top Floor match	30 lbs. of 8d
Top Floor square edge	30 lbs. of 8d

Number of Nails per Pound

Size	Length and Gauge	Approx. No. to Lb.
2d	1 inch No. 15	876
2d	1¼ inch No. 14	568
4d	1½ inch No. 12½	316
5d	1¾ inch No. 12½	271
6d	2 inch No. 11½	181
7d	2¼ inch No. 11½	161
8d	2½ inch No. 10¼	106
9d	2¾ inch No. 10¼	96
10d	3 inch No. 9	69
12d	3¼ inch No. 9	63
16d	3½ inch No. 8	49
20d	4 inch No. 6	31
30d	4½ inch No. 5	24
40d	5 inch No. 4	18
50d	5½ inch No. 3	14
60d	6 inch No. 2	11

Shingling

To find the number of shingles required to cover 100 square feet or one square.

Deduct 3 inches from length of shingle, divide the remainder by three, the result is the exposed length of shingles.

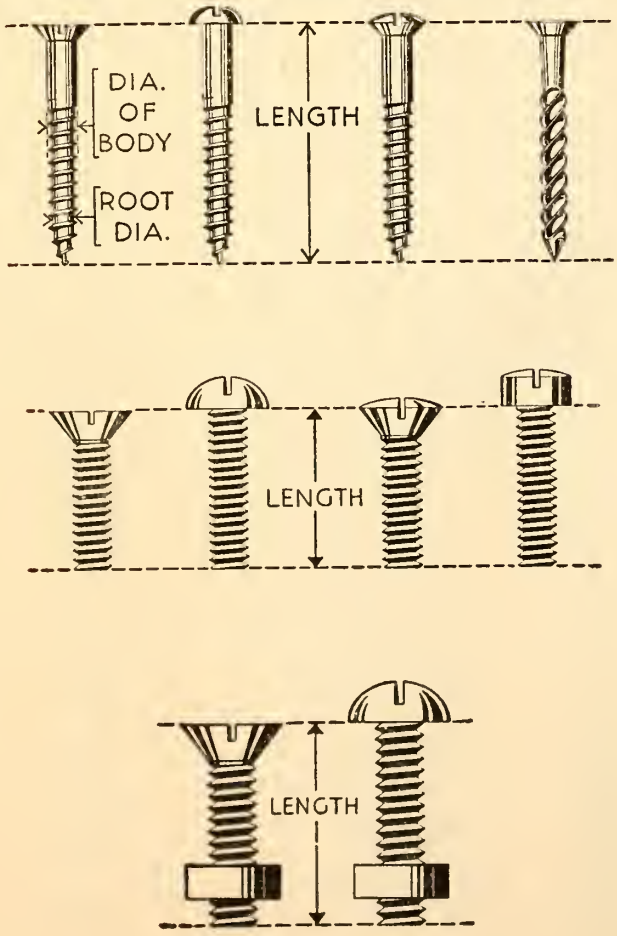
One square equals 14,400 square inches. Divide this number by the exposed surface; equals the required number of shingles.

Note: A shingle is 4 inches wide and of various lengths, as 15, 18, 21, 24, 27 inches.

Table for Estimating Shingles

Length Shingle Inches	Exposed to Weather Inches	Sq. Ft. Covered By 1,000 Shingles		Shingles for 100 Sq. Ft.	
		4 in. Wide	6 in. Wide	4 in. Wide	6 in. Wide
15	4	111	167	900	600
18	5	139	208	720	480
21	6	167	250	600	400
24	7	194	291	514	343
27	8	222	333	450	300

Illustrations showing how the lengths of bolts and screws are determined.



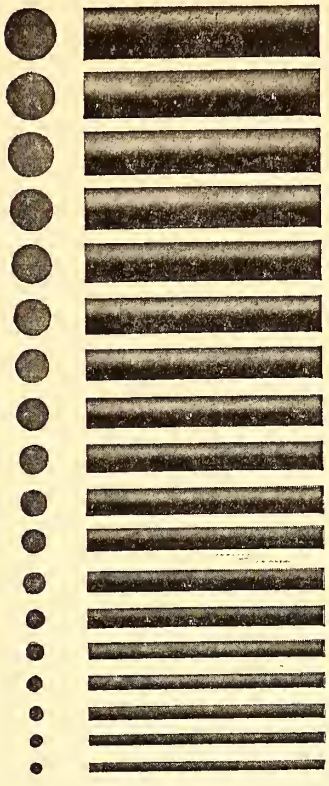
COST OF OPERATING ELECTRIC EQUIPMENT ON THE FARM

Multiply your electric rate by the kilowatt-hours indicated, and you have an average cost of operation. All consumption figures are average and may, in your case, be slightly higher or lower, depending on operating conditions.

In the Home	Kilowatt-Hours per Month
Dishwasher	2¼
Fan	1 for 8 to 10 hrs. operation
Iron	4 (1 per person)
Ironing Machine	8-10
Lighting	25 (including small household appliances)
Oil Furnace (electric control)	200 to 500 per year
Radio	3½ to 12 (average 8)
All electric	3½ to 5
Battery chargers	128 (1 per person per day)
Range	
Refrigerator	20 to 40
Sewing Machine	1 or less
Telechron clock	2
Vacuum cleaner	3 per year
Washing machine	2 (1/3 per person)
Water heater	150 to 600 (average 340)
Water supply	
Shallow well	4½
Cistern	1½

On the Farm	Kilowatt-Hours
Brooding	½ per 6 weeks per chick
Churning	1 per 100 lb. of butter
Corn husking and shredding	5 per ton
Corn shelling (1 to 5 hp.)	1 per 5 bushels
Cream separating	½ per 1000 lbs. of milk
Sterilizing dairy utensils (to 40 cows)	3½ to 7½ per day
Dairy water heating	15 to 35 per 100 gallons
Farm-chore motors (3, 5, 7½ hp.)	3, 5, 7½ per hr. of operation
Farm Shop	½ to 3 per month
Feed Grinding	1/10 to 3 per 100 lbs.
Hay baling (5 hp.)	2 to 4 per ton
Incubating (small)	150-300 per 1000 eggs
Irrigating (surface)	2 to 4 per acre-ft. per ft. lift
Lighting entire farm	25 to 30 per month
Milking	
Portable type	1½ per cow per month
Pipe-line type	2 to 3 per cow per month
Silo Filling	1 to 1½ per ton
Water Supply (All farm uses)	20 to 30 per month

TABLE OF ACTUAL WIRE SIZES

Full Sizes of Plain Wire	Pittsburgh Steel Co's Gauge No.	Diameter of Steel Wire Gauge	Weight One Mile	Feet to a Pound
	1	.2830	1128.0	4.68
	2	.2625	970.4	5.44
	3	.2437	836.4	6.31
	4	.2253	714.8	7.39
	5	.2070	603.4	8.75
	6	.1920	519.2	10.17
	7	.1770	441.2	11.97
	8	.1620	369.6	14.29
	9	.1483	309.7	17.05
	10	.1350	256.7	20.57
	11	.1205	204.5	25.82
	12	.1055	156.7	33.69
	13	.0915	117.9	44.78
	14	.0800	90.13	58.58
	15	.0720	73.01	72.32
	16	.0625	55.0	95.98
	17	.054	41.0	128.60
	18	.047	31.77	166.20

Terracing Table

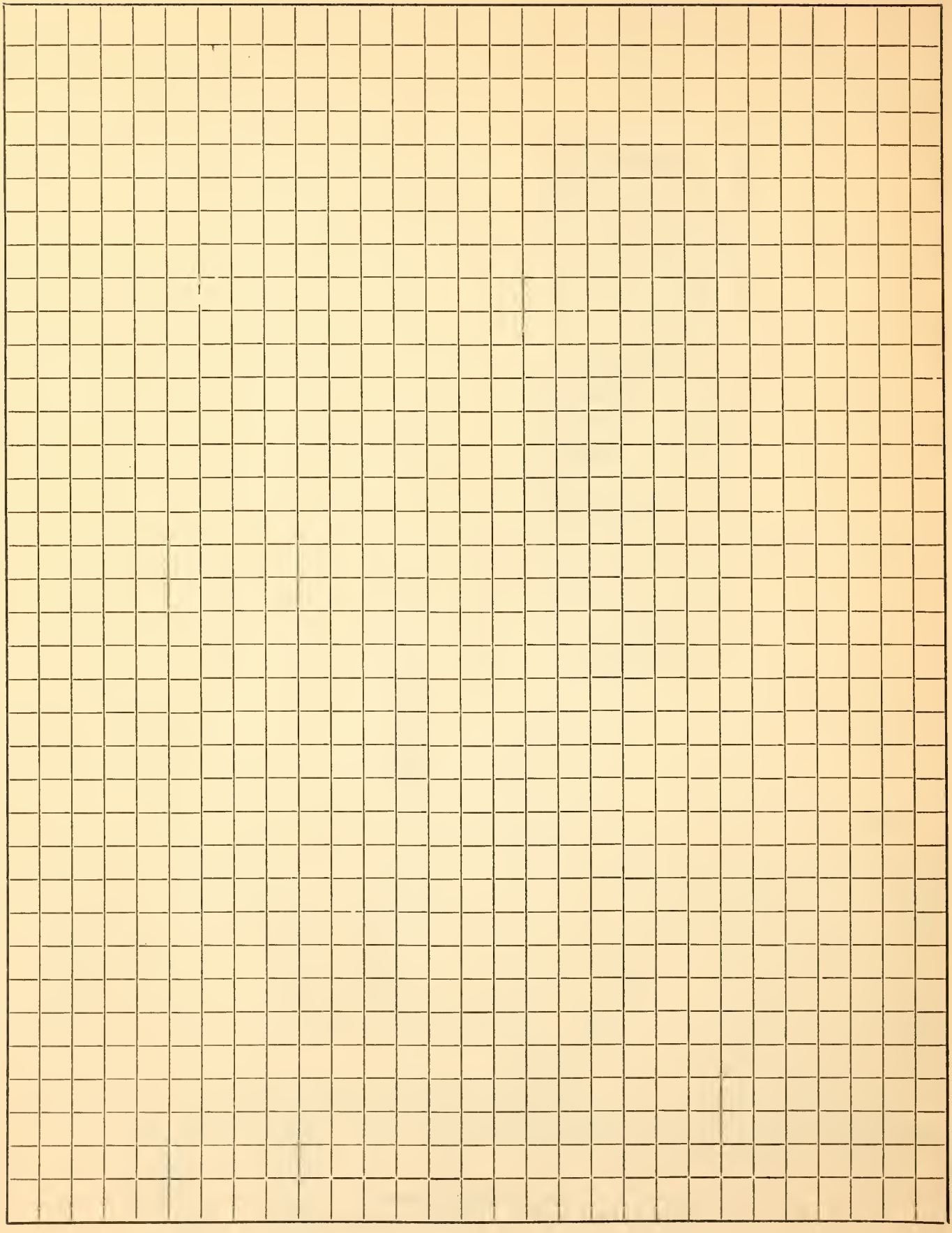
The terracing table gives suggested size, fall, spacing, etc., for terraces according to slope of land.

Slope of land in feet per 100 feet	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Vertical fall between terraces in feet	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7
Distance between terraces in feet	150	100	83	75	70	67	64	62	61	60	59	58
Fall per 100 feet along terrace in inches	0—2	0—3	0—3	0—4	0—4	1—4	1—4	2—4	2—4	2—4	2—4	2—4
Base width of terrace 1st year in feet	22	22	20	20	20	20	20	18	18	18	16	16
Height of ridge while dirt is loose in inches	16	18	18	18	20	20	20	22	22	22	24	24
Linear feet of terrace per acre	290	436	525	581	622	650	681	703	714	726	738	751
Acres terraced per day with 6 mules on V-drag and 2 mules on plow	8–12	5—8	4—6	3—5	3—5	3—4	3—4	3—4	2—4	2—3	2—3	2—3

NOTE.—The use of the above "Table" will be simplified by referring to Figure 2 which shows how to measure the slope of land to apply in the first line of figures in "Table." See Bulletin 51.

Reference to Figure 3 may also help in using the "Table." Terracing Farm Lands in Texas.

The Extension Service
Agricultural and Mechanical College of Texas



FARM SHOP PROJECT REPORT

(When a project or a definite job is completed, this blank is to be filled out. Plans should accompany the report and steps given for construction.)

Name.....Date.....

Project.....

Tools Used.....

.....

Bill of
Material.....

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Time Spent on the Job.....

Value of the Material.....

Value of the Completed Job.....

Labor Income.....

Grade.....

Steps in Construction

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FARM SHOP PROJECT REPORT

(When a project or a definite job is completed, this blank is to be filled out. Plans should accompany the report and steps given for construction.)

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Labor Income.....

Grade.....

Steps in Construction

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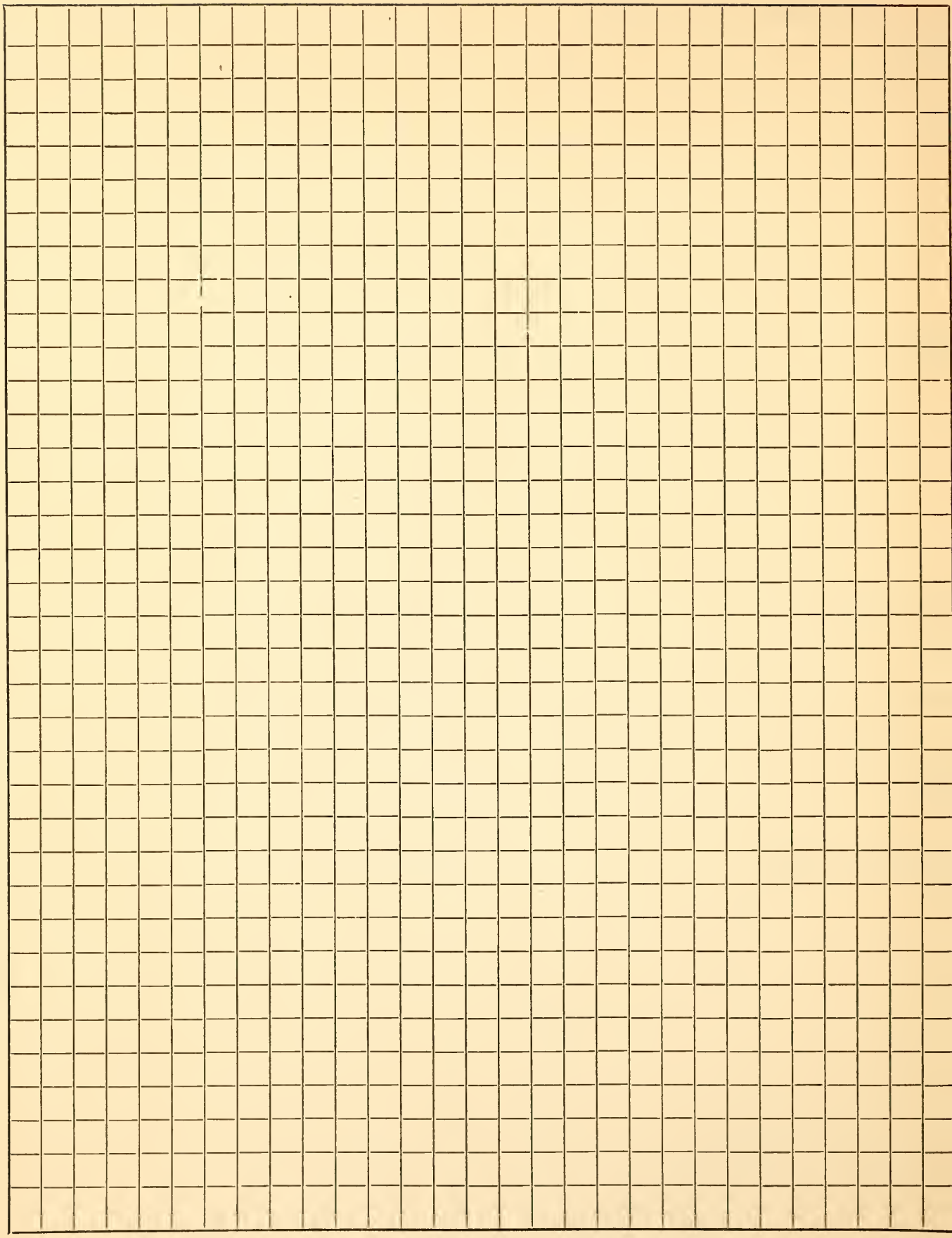

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Project.....

Tools Used.....

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Bill of Material.....

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Time Spent on the Job.....

Value of the Material.....

Value of the Completed Job.....

Labor Income.....

Grade.....

Steps in Construction

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FARM SHOP PROJECT REPORT

(When a project or a definite job is completed, this blank is to be filled out. Plans should accompany the report and steps given for construction.)

Name.....Date.....

Project.....

Tools Used.....

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Bill of Material.....

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Time Spent on the Job.....

Value of the Material.....

Value of the Completed Job.....

Labor Income.....

Grade.....

Steps in Construction

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SUMMARIZED LIST OF JOBS DONE AT HOME

Fill in the blanks below after job is completed

Job	Date	Hours Spent on Job	Cost of Repairs	Increased Value	Grade

NOTES

DRAWINGS

NOTES

DRAWINGS

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